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Water Survey Report No. 5

Skeena River Drainage Basin, Vancouver Island, and
Coastal Areas of British Columbia, 1949-51

By
J. F. J. Thomas



DEPARTMENT OF GEOLOGICAL SCIENCES,
UNIVERSITY OF TORONTO

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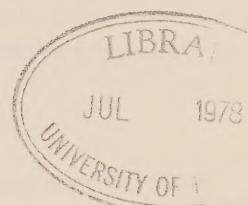
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CONTENTS

	PAGE
Introduction.....	5
Skeena River drainage basin.....	5
Vancouver Island.....	6
Coastal British Columbia.....	6
Survey procedure.....	6
Analytical procedure.....	6
Part I. Surface waters of Skeena River drainage basin, Vancouver Island, and coastal British Columbia.	
Discussion.....	8
Summary.....	29
Part II. Municipal waters within Skeena River drainage basin, on Vancouver Island, and in coastal British Columbia.	
Description of municipal water systems.....	38
Discussion.....	51
Summary.....	51
Appendix A. Sampling locations of surface waters.....	52
Appendix B. Municipalities with organized water systems.....	53

TABLES

I. Comparison of analytical data—Department of Mines and Technical Surveys and British Columbia Research Council.....	7
II. Chemical quality of surface waters.....	10
III. Chemical quality of municipal water supplies.....	31
IV. Municipal water supplies—summary of data on area, total population and population served with water.....	50
V. Municipal water supplies—summary of data on systems including source, treatment and hardness of waters.....	50

FIGURES

1. Map showing location of surface water sampling stations and municipal water supplies.....	in pocket
2. Chart showing variation of water hardness in the Skeena River system.....	9
3. Relationship between mineral content and river discharge in Skeena River, at Usk, B.C.....	26
4. Relationship between mineral content and river discharge in Bulkley River, at Quick, B.C.....	27
5. Relationship between mineral content and river discharge in the Kitsumkalum River, at Terrace, B.C.....	28



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INDUSTRIAL WATER RESOURCES OF CANADA

Chemical Quality of Surface and Municipal Water Supplies in Skeena River Drainage Basin, Vancouver Island, and Coastal Areas of British Columbia, 1949-51

INTRODUCTION

This is the fifth report in a series on the chemical quality of surface waters and municipal water supplies available for industrial and domestic use in Canada. The first four reports in the series cover the scope and procedure of the country-wide survey, the results of studies on Ottawa River, Upper St. Lawrence River-Central Great Lakes, and Columbia River drainage basins.¹

This report gives in detail the results of similar studies carried out during the period 1949 to 1951 in the drainage basin of Skeena River, and on Vancouver Island. Information on the quality of municipal waters and a few surface waters in the coastal area of British Columbia is also included. This coastal area, being only sparsely settled, is not accessible by road. It is probable that future growth of population and industry in this area will necessitate more detailed water quality studies at a later date. The recent plans to develop hydro-electric power and establish aluminium smelting facilities in the Kitimat area on the coast, just south of the Skeena River watershed, is an example of such growth.

The northern part of British Columbia which is drained principally by the Yukon River and Mackenzie River systems is quite extensive, but it, too, is only very sparsely settled. This area will be studied to some extent when survey studies are under way on the Yukon River and Mackenzie River systems.

SKEENA RIVER DRAINAGE BASIN

Skeena River and its tributaries drain about 21,000 square miles, the headwaters being in the coastal ranges adjacent to streams flowing into the large Fraser River and Yukon River systems.

Skeena River and its large tributary, Bulkley River, provide the passes through which highway and railway reach the Pacific coast at Prince Rupert. The elevation above sea-level along this system is never very great and the river valleys provide considerable arable land. Prior to the building of the railroad and the highway, agriculture, fishing, and logging were the main activities in the area and this river system was the principal means of transportation. Population and industrial activity in the valleys are increasing rapidly.

Rainfall in most of this basin is plentiful and the country is heavily wooded, especially along the coast. Unlike the areas drained by Fraser and Columbia Rivers, irrigation does not play a major role in the economy of this basin.

Skeena River and its tributaries, in so far as studied, are fast, turbulent waters, except in the lake regions near the headwaters of the system. Bulkley River, at times, flows turbulently through very deep gorges; Skeena River is a mighty torrent throughout much of its course, too rapid even for safely transporting logs. In its lower reaches Skeena River widens and becomes tidal. Ships can proceed several miles upstream and here salmon fishing is an important industry.

¹ Industrial Water Resources of Canada (Water Survey Rept. No. 1): Scope, Procedure, and Interpretation of Survey Studies; Mines Branch Rept. No. 833, Dept. of Mines and Technical Surveys, Ottawa.

Industrial Water Resources of Canada (Water Survey Rept. No. 2): Ottawa River Drainage Basin, 1947-48; Mines Branch Rept. No. 834, Dept. of Mines and Technical Surveys, Ottawa.

Industrial Water Resources of Canada (Water Survey Rept. No. 3): Upper St. Lawrence River—Central Great Lakes in Canada; Mines Branch Rept. No. 837, Dept. of Mines and Technical Surveys, Ottawa.

Industrial Water Resources of Canada (Water Survey Rept. No. 4): Columbia River Drainage Basin in Canada, 1949-50; Mines Branch Rept. No. 838, Dept. of Mines and Technical Surveys, Ottawa.

VANCOUVER ISLAND

The main activities on this island, which is 13,210* square miles in area, are logging, coal mining, fishing, and the production of pulp and paper. The island is the home of many retired people, a major tourist resort, and the seat of the Provincial Government. Except for the area around Port Alberni and Alberni, only the eastern and southern parts of the island are settled and readily accessible by road.

The rivers, which are many due to the heavy rainfall and the wooded character of the island, are of short length and not nearly so turbulent and turbid as most of the mainland streams.

COASTAL BRITISH COLUMBIA

This area, about 97,200 square miles, includes all of British Columbia except Vancouver Island and that part of the mainland not drained by the Fraser River, Columbia River, Skeena River, and Mackenzie River systems. The area is generally very rugged and mountainous and some parts have scarcely been explored. Much of the region is now accessible only by coastal steamer or by air and there are few settlements other than small, coastal, fishing and logging towns.

SURVEY PROCEDURE

The methods of sampling and general survey procedure used in this investigation were essentially those reported in detail in Water Survey Report No. 1.¹

Studies of water quality on Vancouver Island were carried out during the summer of 1949, after the author had completed field work in the Columbia River basin. No monthly stations were operated on the rivers of the island, as these rivers are generally small and the constancy of precipitation and climate makes it doubtful if any important seasonal variation in water quality will occur.

The Skeena River system was studied during the period 1950 to 1951 at the same time that studies were being carried out on water quality in the large Fraser River system. Only four sampling stations were operated in this watershed: one daily station on Skeena River at Usk; and three monthly stations, two on Bulkley River at Hazelton and at Quick and one on Kitsum-kalam River near Terrace, B.C.

At Usk, samples were collected daily from midstream into 16-ounce, pressure-sealed bottles which were shipped thrice-monthly by the collector to the British Columbia Research Council laboratory at Vancouver. Here, all data regarding the water temperature, water level, etc., were recorded, each daily sample was tested for specific conductance, and a 10-day composite sample was prepared. The composite samples were tested for pH, colour, turbidity, specific conductance, and alkalinity, and then were shipped to the Mines Branch laboratory at Ottawa, where a complete analysis was carried out.

Monthly samples collected at the three other stations over the 1-year period were shipped directly to the laboratory at Ottawa. Whenever possible, samples were also taken at these stations when the river was at high and low flow.

During the summer of 1950, field studies were carried out in this basin using the mobile laboratory. Samples of the few municipal waters in the area were obtained and additional samples of river and lake waters were collected.

No systematic studies were made on any of the rivers in the coastal area of British Columbia. Officials of the few municipalities having organized water works co-operated in the survey by forwarding water samples to Ottawa and supplying information on the operation of their systems.

ANALYTICAL PROCEDURE

Water Survey Report No. 1¹ outlines the methods of analyses and the method of reporting analytical results used in this survey.

The monthly samples which were shipped directly to the laboratory at Ottawa were stored, unopened, in the dark until analysis could be started. It will be noted that storage time on

¹ Industrial Water Resources of Canada (Water Survey Rept. No. 1): Scope, Procedure, and Interpretation of Survey Studies; Mines Branch Rept. No. 833, Dept. of Mines and Technical Surveys, Ottawa.

¹ Op. cit.

* Includes also several small nearby islands.

these samples was usually brief. All samples collected after June 15, 1950, were immediately tested for pH, colour, turbidity, alkalinity, specific conductance, chloride, and total hardness, upon receipt in the laboratory. These determinations are those that will normally be affected by long storage. Most of the samples collected on the Skeena River system and obtained from coastal municipalities were so tested. However, storage time on samples collected after June 15 is still reported as the total time elapsing between sampling and the start of final analysis, even though most of these waters were tested for unstable constituents within 7 days.

The tests carried out by the British Columbia Research Council on the daily samples collected at Usk were repeated in the Ottawa laboratory. The comparison of results in these two laboratories is shown in Table I. This table shows the arithmetical mean of results on the composite samples and also reports the maximum and minimum differences found in any value.

TABLE I
COMPARISON OF ANALYTICAL DATA

Source of water.....	Skeena River,		Individual differences	
	Usk, B.C.		Maximum	Minimum
Sampling point.....	D.M.T.S. ¹	B.C.R.C. ²		
Testing laboratory.....				
No. of samples (Feb. 1/50 to Jan. 31/51 incl.).....	34*	35*	.....	.....
Average storage (days), immediate testing.....	26	13	41	7
Average water level (feet).....	12.9	12.9	.....	.....
Average water temperature, °C.....	44.2	44.2	.....	.....
Average test temperature, °C.....	22.5	23.2	5.9	0
Average pH.....	7.5	7.6	0.5	0
Average colour, p.p.m.....	11	19	75	0
Average turbidity, p.p.m.....	19	19	35	0
Average alkalinity, as p.p.m. CaCO ₃ :				
(phenolphthalein alkalinity.....	0	0	0	0
(methyl orange alkalinity.....	47.8	44.9	7	0
Average specific conductance, micromhos @ 25°C.....	109.9	111.2	16.9	0.5
Average specific conductance, from daily samples.....		110.9	.....	.....

¹ Department of Mines and Technical Surveys.

² British Columbia Research Council.

* Composite samples.

It will be noted that the major differences between the two laboratories are in the determinations for colour and turbidity. These variations can, it is believed, be considered due to differences in length of storage and the recognized poor precision of the routine test methods for colour and turbidity. It is known that storage of waters may cause bleaching or loss of colour and coagulation or settling of turbidity. However, even though storage time was on the average twice as long when testing was carried out at Ottawa, the procedure used does give satisfactory agreement with results obtained at the British Columbia Research Council for pH and alkalinity, two values that often show considerable change during storage and shipment.

PART I

SURFACE WATERS OF THE SKEENA RIVER DRAINAGE BASIN, VANCOUVER ISLAND, AND COASTAL BRITISH COLUMBIA

SKEENA RIVER DRAINAGE BASIN

Daily samples were collected of Skeena River from the ferry at Usk, B.C., and monthly samples of Bulkley River at New Hazelton and Quick, and of Kitsumkalum River near Terrace, B.C., during the period, February 1950 to February 1951. At New Hazelton, ice conditions and inaccessibility to the sampling location prevented sampling during the winter months.

During the summer of 1950 the basin was travelled with the mobile laboratory and samples of surface waters and municipal supplies were collected. The locations of all surface water sampling points within this watershed are listed in Appendix A and are shown on the map of the basin, Figure 1 (in map pocket).

Because of the inaccessibility by road of a considerable part of the watershed, several large tributaries were not studied. These rivers can, it is believed, be assumed to be similar in quality to those already studied, as their source is either in the same area or they traverse the same terrain as the streams studied. These areas are only sparsely settled and domestic and industrial use of water is practically nil.

VANCOUVER ISLAND

No monthly or daily sampling stations were operated on the small rivers of the island. During the summer of 1949 the settled and accessible parts of the island were visited with the mobile laboratory and most of the larger rivers, lakes, and municipal water supplies were sampled. The location of these sampling points, which are listed in Appendix A, are shown in Figure 1.

COASTAL BRITISH COLUMBIA

No studies were made of surface waters within this sparsely settled coastal area which includes the coastal islands not already included in the Vancouver Island area. Most of the rivers are of very short length, rising in the coastal range west of the Fraser River drainage basin. At present these rivers are of little industrial importance.

The few surface waters reported are those used by coastal municipalities for domestic supplies. They are listed in Appendix A and their locations are shown in Figure 1.

Table II tabulates in detail the results of chemical analyses carried out on the surface water samples collected at the sampling locations shown in Figure 1.

Since many of these surface waters are used by municipalities without treatment or only after chlorination, their analyses will be found repeated in Table III, Part II.

The average analysis is determined for the sampling period at the one daily and three monthly stations. This average is the arithmetical mean of each major constituent over the period and is not weighted as to river flow.

Per cent sodium, a value of some importance in assessing the suitability of a water for irrigation, and the saturation index, have been calculated for all waters. The reader is referred to Water Survey Report No. 1 for the interpretation of per cent sodium, saturation index, and other values reported in Table II.

Figure 2 shows graphically the variation in total and non-carbonate hardness in the Skeena River system. The relationship between river flow and mineral content of the Skeena River at Usk and the Bulkley River at Quick, is graphically shown in Figures 3 and 4 respectively. Figure 5 shows the same relationship in the Kitsumkalum River near Terrace, B.C.

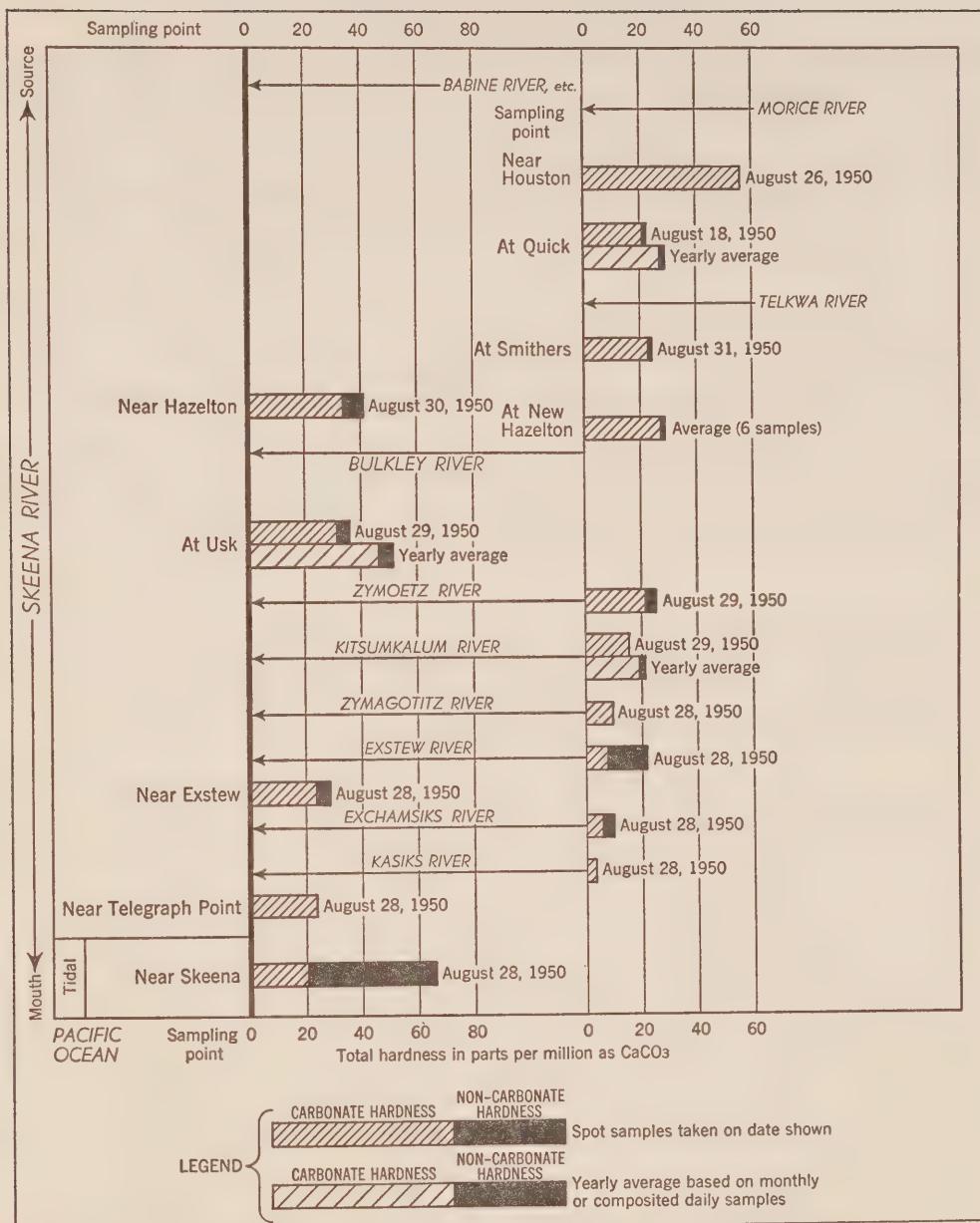


FIGURE 2. GRAPH SHOWING CHANGE IN HARDNESS ALONG SKEENA RIVER WATERSHED

TABLE II
Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia
(In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second-feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Specific conductance $K \times 10^6$ at 25°C.	Residue on Evaporation at 105°C. (Dissolved solids)			Loss on ignition at 550°C.	Calcium (Ca)
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.	P.P.M.	Tons per acre-foot	Tons per day $\times 10^3$			

STATION NO. 1: SKEENA RIVER near SKEENA,

1	Aug. 28/50.....	4800	136	55	7.0 (1.3)	15 (7.3)	35 (40)	736	10.0
---	-----------------	------	-----	-------	----	-------	--------------	-------------	------------	-------	-------	-----	-------	-------	-------	-------	------

* At high tide, 5 foot depth.

STATION NO. 2: SKEENA RIVER near

2	Aug. 28/50.....	4817	142	55	1.5 (1.5)	7.2 (7.6)	5 (30)	20	375	325	54.8	41.4	0.056	12.2	7.6
---	-----------------	------	-----	-------	----	-------	--------------	--------------	-----------	----	-----	-----	------	------	-------	-------	------	-----

** At high tide, 5 foot depth.

STATION NO. 3: SKEENA RIVER

3	Aug. 28/50.....	4818	142	54	7.1 (2.0)†	15 (7.6)	15 (30)	25	327	294	61.4	52.4	0.071	18.6	9.2
---	-----------------	------	-----	-------	----	-------	---------------	-------------	------------	----	-----	-----	------	------	-------	-------	------	-----

† Values in brackets are results of tests carried out in the mobile laboratory immediately after sampling.

STATION NO. 4: SKEENA RIVER at

4	Feb. 1-10/50....	3975	32	2,020	2,290	37	.....	7.7	5	0.5	.....	137	91.0	0.124	0.50	6.0	21.6	
5	11-20.....	4011	28	2,320	2,290	36	.....	7.8	0	0.5	.....	129	83.0	0.113	0.52	8.0	18.6	
6	21-28††.....	.....	2,585	2,290	37	.....	(7.8)	(4)	(1)	.....	(126)	.....	.....	.....	.....	.....	.....
7	Mar. 1-10.....	4096	27	7,210	10,300	38	.....	7.7	8	2	.....	125	84.0	0.114	1.63	5.6	20.6	
8	11-20.....	4116	33	12,110	10,300	38	.....	7.9	5	0.5	.....	131	83.8	0.114	2.74	6.6	19.4	
9	21-31.....	4165	37	11,500	10,300	40	.....	7.6	5	5	9.4	8.6	127	80.4	0.109	2.48	6.2	17.2
10	April 1-10.....	4156	22	6,510	6,330	39	.....	7.8	5	5	4.6	3.2	128	88.4	0.120	1.55	10.0	21.6
11	11-20.....	4205	24	5,560	6,330	40	.....	7.8	15	5	11	8.8	126	83.8	0.114	1.27	9.8	18.8
12	21-30.....	4223	23	7,210	6,330	42	.....	7.7	20	5	13	12	117	81.0	0.110	1.55	10.8	16.4
13	May 1-10.....	4274	32	21,510	40,100	45	.....	7.5	30	25	44	42	90.6	75.0	0.102	4.35	14.6	13.5
14	11-20.....	4304	36	54,770	40,100	43	.....	7.4	25	8	15	13	74.9	60.6	0.083	9.00	12.6	10.9
15	21-31.....	4307	25	43,670	40,100	44	.....	7.4	20	8	16	14	79.4	60.4	0.082	7.10	14.0	10.8
16	June 1-10.....	4361	37	95,880	129,100	46	.....	7.4	15	125	176	166	61.9	109	0.148	28.20	53.6	10.1
17	11-20.....	4383	19	188,800	129,100	53	.....	7.3	50	230	278	261	59.7	53.0	0.072	26.90	11.8	8.6
18	21-30.....	4508	82	101,690	129,100	52	.....	7.3	25	95	135	128	73.9	62.2	0.085	17.10	13.2	12.4

†† Preliminary data from B.C. Research Council; sample lost during shipment.

TABLE II—Continued
 Chemical Analysis of Surface Waters in the Skeena River Basin Drainage, on Vancouver Island, and in
 Coastal British Columbia
 (In parts per million)

Magnesium (Mg.)	Alkalies		Iron (Fe)		Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Fluoride (F)	Boron (B)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents	Per cent sodium	Saturation Index	No.
	Sodium (Na)	Potassium (K)	Total	Dissolved								Gravimetric	Colorimetric	Non-carbonate	Total				

B.C.*—Drainage area, about 21,000 square miles.

10.0	106	5.6	30.0	189	0	25.6 (23.2)	0 (0)	6.8	45.0	66.0	370	76	2.1	1
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TELEGRAPH POINT, B.C.**

1.2	1.7	0.7	1.8	0.1	11.5	0	0.3	0	29.3 (25.6)	0 (0)	1.8	0	24.0	39.3	13	2.1	2
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near EXSTEW, B.C.

1.3	1.5	0.6	2.0	0.2	17.7	0	0.3	0.10	29.8 (25.6)	0 (0)	3.7	4.1	28.5	49.3	10	2.0	3
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USK, B.C.—Drainage area, 15,000 square miles.

3.2	2.9	0.6	0.09	18.8	0	0.4	0.05	0.02	70.8	0	8.8	8.4	9.1	67.1	91.0	4
3.1	2.8	0.4	.....	0.15	13.3	0	1.1	0.10	.....	64.7	0	8.0	5.1	6.2	59.2	76.6	.....	5
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(62.2)	(0)	.....	.....	.....	.....	.....	.....	6
3.1	2.8	0.2	.....	0.23	14.2	0	0.8	0.10	0.12	67.8	0	6.2	6.6	8.6	64.2	82.5	.....	7
3.0	2.8	0.5	.....	0.10	17.1	0	0.7	0	.....	67.8	0	5.8	5.6	5.1	60.7	83.0	.....	8
3.7	2.6	0.8	0.84	0.11	12.0	0	0.5	0.10	.....	65.4	0	7.6	6.9	4.5	58.1	76.1	.....	9
3.5	2.7	0.3	0.34	0.04	18.0	0	0	0.15	0.05	67.1	0	7.4	6.8	13.3	68.3	86.2	.....	10
3.2	3.4	0.4	0.60	0.07	12.7	0	0.6	0.08	.....	64.9	0	5.6	5.6	6.9	60.1	78.8	.....	11
2.3	2.8	0.6	0.84	0.09	9.2	0	0.5	0	.....	59.5	0	6.8	6.1	1.6	50.4	67.3	.....	12
1.8	2.4	1.2	3.5	0.40	16.8	0	1.3	0.10	.....	48.3	0	7.8	5.0	1.5	41.1	66.3	.....	13
1.7	1.8	0.3	1.4	0.20	6.4	0	1.2	0.10	0	39.5	0	7.2	4.5	1.8	34.2	46.6	.....	14
1.6	1.8	0.3	1.8	0.20	6.9	0	0.7	0.20	.....	39.8	0	7.6	4.6	0.9	33.5	46.7	.....	15
1.5	1.8	0.3	10.1	0.16	5.1	0	0.4	0	.....	31.7	0	.....	5.0	5.4	31.4	40.0	.....	16
1.3	1.8	1.1	9.3	0.41	8.4	0	0.9	.....	0	29.3	0	.....	3.4	2.8	26.8	40.3	.....	17
1.7	1.6	0.8	12.5	0.39	11.9	0	0.9	0	.....	34.9	0	.....	7.8	9.3	37.9	54.7	.....	18

TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in Coastal British Columbia

(In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Specific conductance $K \times 10^6$ at 25°C.	Residue on Evaporation at 105°C. (Dissolved solids)			Loss on ignition at 550°C.	Calcium (Ca)
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.	P.P.M.	Tons per acre-foot	Tons per day $\times 10^3$			
1	July 1-10....	4509	71	56,780	44,500	56	.....	7.4	15	20	58	55	96.6	68.2	0.093	10.50	11.4	15.8
2	11-20....	4528	48	43,230	44,500	57	.....	7.4	5	35	25	23	91.4	57.6	0.078	6.68	5.4	14.1
3	21-31....	4647	101	34,570	44,500	58	.....	7.8	8	7	22	20	90.3	57.6	0.078	5.35	10.8	12.6
4	Aug. 1-10....	4652	90	34,920	29,000	56	.....	7.2	7	15	20	18	88.1	57.0	0.078	5.40	8.8	11.8
5	11-20....	4676	92	27,880	29,000	57	.....	7.5	2	8	12	9.9	97.4	60.8	0.083	4.59	7.4	14.4
6	29*....	4792	132	23,200	29,000	55	.....	7.4	15	35	27	26	79.3	53.2	0.072	3.32	6.4	11.6
7	Aug. 21-31/50....	4703	93	24,580	29,000	59	.....	7.8	10	15	5.6	4.8	98.9	63.4	0.086	4.19	6.4	15.2
8	Sept. 1-9....	No sample.		25,440	21,600														
9	10-19....	4735	81	18,530	21,600	57	.....	7.4	5	1	.....		130	72.0	0.098	3.60	8.0	16.7
10	20-30....	4706	63	21,670	21,600	55	.....	7.4	1	15	14	12	100	63.6	0.086	3.69	4.6	14.6
11	Oct. 1-10....	4766	67	14,050	11,900	52	.....	7.5	1	7	6.3	3.1	126	80.8	0.110	3.06	8.2	18.4
12	11-20....	4856	110	12,940	11,900	48	.....	7.6	10	0.7	.....		121	81.0	0.110	2.82	10.2	18.0
13	21-31....	4857	100	9,060	11,900	44	.....	7.5	7	0.8	.....		159	81.0	0.110	1.98	10.6	23.9
14	Nov. 1-10....	4909	109	12,770	10,200	41	.....	7.5	10	9	5.4	2.7	109	93.2	0.127	3.21	17.2	20.5
15	11-20....	4887	89	8,150	10,200	36	.....	7.5	5	0.5	.....		142	97.0	0.132	2.13	12.0	23.0
16	21-30....	4870	73	9,720	10,200	34	.....	7.4	7	3	.....		128	83.0	0.113	2.18	10.0	19.1
17	Dec. 1-10*....	4873	53	6,550	7,330	34	.....	7.2	7	6	15	12	85.1	52.4	0.071	0.92	7.0	12.0
18	11-20....	4910	69	7,600	7,330	36	.....	7.4	5	0.5	.....		108	72.0	0.098	1.48	10.6	17.2
19	21-31....	4912	59	7,790	7,330	36	.....	7.7	6	1	.....		117	76.8	0.104	1.61	8.2	17.3
20	Jan. 1-10/51....	4917	52	7,230	6,900	36	.....	7.6	5	0.8	.....		126	82.6	0.113	1.62	9.6	19.0
21	11-20....	4921	42	6,940	6,900	35	.....	7.4	5	0.3	.....		131	81.2	0.110	1.51	11.4	19.3
22	21-31....	4952	43	6,550	6,900	34	.....	7.7	10	0.3	.....		133	84.0	0.114	1.48	10.0	19.3
23	Average (34 samples)....		58	27,360	26,620	44	.....	7.5	10	19	.....		110	75.3	0.102	5.08	10.9	16.6

* Field sample not included in average.

** Samples for 4 days had very low conductivity indicating possible collection of surface snow water.

STATION NO. 5: SKEENA RIVER near

24	Aug. 30/50....	4793	131	52	(1.2)	7.4	15	25	(30)	28	26	88.6	66.6	0.091	8.2	12.8
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TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia
(In parts per million)

Magnesium (Mg.)	Alkalies		Iron (Fe)								Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents	Per cent sodium	Saturation index + - -	No.
	Sodium (Na)	Potassium (K)	Total	Dissolved	Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Fluoride (F)	Boron (B)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Gravimetric	Colorimetric	Non-carbonate	Total			

at USK, B.C. (Continued)

1.9	1.8	0.5	3.7	0.14	12.7	0	1.1	0.10	.....	46.4	0	.....	6.4	0.2	47.2	63.3	.....	1
1.9	1.6	0.3	1.9	0.09	8.9	0	0.6	0	.....	46.4	0	.....	5.4	5.0	43.0	55.8	.....	2
1.8	1.6	0.4	1.2	0.05	8.4	0	0.8	.....	.....	46.4	0	.....	4.0	0.8	38.8	52.6	.....	3
2.0	1.6	0.3	1.1	0.04	7.4	0	1.1	.....	Trace	43.4	0	.....	3.9	2.0	37.6	49.5	.....	4
2.0	1.8	0.2	0.76	0.03	9.9	0	0.5	0.05	.....	48.1	0	.....	5.0	4.7	44.1	57.6	.....	5
1.8	1.5	0.4	1.5	0.12	7.7	0	0	0.05	.....	39.0	0	.....	4.6	4.3	36.3	47.0	.....	6
1.9	1.8	0.4	1.2	0.06	10.0	0	0.6	0.05	.....	(37.8)	(0)	.....	(9.0)	(40.0)	.....	.....	.....	7
										51.2	0	.....	5.8	3.7	45.7	61.3	.....	8
2.0	2.0	0.4	.....	0.24	13.2	0.5	0.8	0.10	.....	53.7	0	5.0	4.0	5.9	49.9	66.4	.....	9
2.0	1.8	0.4	0.60	0.06	10.5	0	0.4	0.05	.....	44.4	0	.....	4.9	8.2	44.6	56.6	.....	10
2.7	1.9	0.7	0.60	0.02	10.5	0	0.4	0	0	64.7	0	.....	5.8	4.0	57.0	72.3	.....	11
2.8	3.1	0.6	.....	0.12	11.0	0	0.7	0	.....	63.7	0	.....	7.0	4.3	56.5	74.7	.....	12
3.5	2.8	0.5	.....	0.04	10.7	0	0.8	0	.....	84.2	0	.....	7.0	5.0	74.0	90.7	.....	13
2.2	1.8	0.4	0.30	0.19	9.4	0	0.9	.....	0.03	56.4	0	.....	2.3	14.0	60.2	65.5	.....	14
3.1	2.3	0.4	.....	0.33	11.2	0	0.9	0.05	.....	76.0	0	.....	6.2	7.1	70.1	85.3	.....	15
2.9	2.7	0.7	.....	0.16	9.7	0	2.7	0.05	.....	66.4	0	.....	5.7	5.2	59.6	76.4	.....	16
1.9	1.6	0.3	1.1	0.03	6.6	0	1.5	0.10	.....	44.9	0	.....	3.7	1.0	37.8	49.8	.....	17
2.5	2.0	0.3	.....	0.02	10.4	0	0.9	.....	.....	58.6	0	.....	2.6	5.2	53.2	64.7	.....	18
2.5	2.0	0.3	.....	0.03	9.2	0	0.9	.....	.....	61.7	0	.....	2.8	2.9	53.5	65.4	.....	19
2.8	2.3	0.2	.....	0.09	10.9	0	1.3	0	0	66.1	0	2.2	3.5	4.7	58.9	72.7	.....	20
2.9	2.3	0.3	.....	0.04	11.9	0	0.7	0	0	68.1	0	5.4	3.4	4.3	60.1	74.4	.....	21
2.9	2.3	0.2	.....	0.13	13.5	0	0.9	0	.....	67.8	0	6.6	5.5	4.5	60.1	78.1	.....	22
2.4	2.2	0.5	.....	0.13	11.1	0	0.8	.....	.....	56.4	0	.....	5.2	5.3	51.3	66.7	8.5	1.5 23

HAZELTON, B.C., above mouth of BULKLEY RIVER.

2.3	1.8	0.5	1.9	0.28	10.9	0	1.2	0	0	41.5 (39.0)	0 (0)	6.0	7.4	41.4	56.2	8.5	1.7 24
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TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia
(In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second-feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Specific conductance $K \times 10^4$ at 25°C.	Residue on Evaporation at 105°C. (Dissolved solids)			Loss on ignition at 550°C.	Calcium (Ca)
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.	P.P.M.	Tons per acre-foot	Tons per day $\times 10^4$			
1	Aug. 28/50.....	4603	58	.....	.....	62	.....	.....	7.5 (1.3)	15 (40)	0.2 (clear)	.....	.....	28.2	27.4	0.037	.....	10.4	4.9

STATION No. 6: WOODWORTH LAKE

1	Aug. 28/50.....	4603	58	62	7.5 (1.3)	15 (40)	0.2 (clear)	28.2	27.4	0.037	10.4	4.9
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STATION No. 7: KOGIA RIVER

2	Aug. 28/50.....	4789	128	60	7.3 (11.0)	40 (3.3)	5	4.8	2.2	177	105	0.143	28.8	2.8
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STATION No. 8: KASIKS RIVER

3	Aug. 28/50.....	4801	136	53	6.5 (2.7)	7 (7.0)	4 (15)	11.8	1.3
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STATION No. 9: EXCHAMSIKS

4	Aug. 28/50.....	4756	102	48	6.6 (1.7)	15 (6.8)	15 (12)	21.3	3.8
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STATION No. 10: EXSTEW

5	Aug. 28/50.....	4757	102	46	6.7 (1.0)	25 (1.0)	25 (30)	14.8	7.8
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STATION No. 11: ZYMAGOTITZ RIVER (ZIMACORD)

6	Aug. 28/50.....	4802	136	50	7.0 (1.7)	4 (7.1)	15 (10)	22.2	4.0
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STATION No. 12: KITSUMKALUM RIVER at highway

7	Feb. 28/50.....	4012	16	536	484	34	7.5	8	7	6.4	4.8	59.8	42.4	0.058	62	6.0	8.2
8	Mar. 18.....	4095	14	580	605	35	.....	.....	7.5	15	5	4.4	2.8	58.8	46.0	0.063	72	6.4	9.4
9	April 18.....	4179	16	830	1,120	39	.....	.....	7.6	5	9	8.4	6.4	53.3	39.6	0.054	89	9.0	7.8
10	May 21.....	4268	11	3,200	3,930	46	.....	.....	7.1	10	7	.....	.....	47.2	.....	.....	.....	.....	8.0
11	June 19.....	4402	38	24,200	12,600	45	.....	.....	7.3	30	65	59	55	44.7	40.4	0.055	2,640	5.6	6.5
12	July 17.....	4501	56	6,230	7,420	54	.....	.....	7.4	3	30	18	16	38.7	35.8	0.049	605	6.0	5.6
13	Aug. 18.....	4641	78	5,190	5,940	56	.....	.....	7.3	7	25	.....	.....	38.6	.....	.....	.....	.....	6.3

TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia.
(*In parts per million*)

Magnesium (Mg.)	Alkalies		Iron (Fe)		Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Fluoride (F)	Boron (B)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents	Per cent sodium	Saturation index	No.
	Sodium (Na)	Potassium (K)	Total	Dissolved								Gravimetric	Colorimetric	Non-carbonate	Total				

at PRINCE RUPERT, B.C.

0.1	1.1	0.2	0.17	3.8	0	0	0.20	12.0 (11.0)	0 (0)	2.0	2.0	11.7 (12.0)	21.5 (21.0)	17.4	15.7	2.1	1
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near PRINCE RUPERT, B.C.

1.8	22.7	1.2	0.34	0.10	9.4	39.6	0.4	9.5	0	2.1	6.6	14.4	84.8	75.6	2.7	2
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from highway bridge near SALVUS, B.C.

0.1	0.9	0.4	2.1	0	0	8.5 (6.1)	0 (0)	3.6	0 (0)	3.6 (4.0)	12.6	31.7	3.8	3
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RIVER near SALVUS, B.C.

0.1	0.5	0.2	5.8	0	0	7.3 (4.9)	0 (0)	0.8	3.9	9.9	14.8	9.8	3.4	4
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RIVER near SHAMES, B.C.

0.6	0.6	0.4	1.7	0	0	9.3 (6.1)	0 (0)	0.7	14.4	22.0	16.4	5.5	2.8	5
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RIVER) from highway bridge near AMSBURY, B.C.

0.7	1.4	0.8	2.1	0	0	8.5 (11.0)	0 (0)	8.4	0 (1.0)	9.9 (10.0)	21.6	14.4	2.7	6
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bridge near TERRACE, B.C.—Drainage area, 1,090 square miles.

1.1	1.6	0.9	0.47	0.05	10.4	0	0.4	0.05	30.5	0	7.0	5.0	0	25.0	42.7	7
1.1	1.6	0.8	0.89	0.26	9.1	0	0.5	0	0.06	28.8	0	4.6	5.4	4.4	28.0	42.5	.....	.....	8
0.4	1.3	0.9	0.59	0.04	6.9	0	0	0.10	.....	24.4	0	5.2	4.8	1.2	21.2	34.2	.....	.....	9
0.8	1.1	0.9	.....	.....	4.6	0	.....	.....	0	26.4	0	.....	4.6	1.7	23.3	33.0	.....	.....	10
1.4	1.3	1.0	3.2	0.66	5.6	0	0.5	0.05	.....	22.9	0	.....	4.4	3.2	22.0	32.7	.....	.....	11
1.7	1.2	0.8	3.3	0.47	6.7	0	0.4	0.05	.....	21.5	0	6.8	.....	3.4	21.0	31.9	.....	.....	12
0.4	0.9	0.8	.....	.....	3.7	0	.....	0.02	17.1	0	.....	3.8	3.8	17.3	24.4	.....	.....	13	

TABLE II—Continued
 Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
 Coastal British Columbia
 (In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second-feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Specific conductance $K \times 10^4$ at 25°C.	Residue on Evaporation at 105°C. (Dissolved solids)		Loss on ignition at 550°C.	Calcium (Ca)
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.	P.P.M.	Tons per acre-foot	Tons per day $\times 10^3$		

STATION No. 12: KITSUMKALUM RIVER at highway

1	29*.....	4777	108	6,180	5,940	50	(13.5)	(1.7)	7.1	5	20	(30)	.....	36.4	.....	.....	5.4
2	Sept.	No sample taken.	.....	.....	4,530	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.4
3	Oct. 18.....	4825	96	2,350	1,820	44	.....	.....	7.2	5	40	.....	22	20	42.4	40.6	0.055
4	Nov.	No sample taken.	.....	.....	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.2
5	Dec. 31.....	4892	45	.....	No record	39	.....	.....	7.3	10	25	.....	.....	46.3	.....	.....	13.0
6	Jan. 25/51.....	4922	32	“	“	35	.....	.....	6.9	5	3	.....	.....	70.5	55.8	0.076	9.1
7	Average (11 samples).....	46	.....	.....	.....	43	.....	.....	7.3	9	20	.....	.....	48.8	42.9	0.058	8.6
																	7.1

* Field sample included in average as Sept. sample.

STATION No. 13: ZYMOETZ (COPPER)

8	Aug. 29/50.....	4803	135	50	(14.0)	(1.1)	7.4	7	10	(20)	72.6	9.0
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STATION No. 14: BULKLEY RIVER

9	Feb. 50.....	No sample—river frozen.
10	Mar.	“	“
11	April	“	“
12	May 18/50.....	4309	33	24.6*	39	7.3	35	15	23	21	69.8	69.4	0.094	16.4
13	June 16.....	4364	26	39.5	.....	50	.....	.....	7.5	10	215	249	236	51.7	89.8	0.122	45.4
14	July 19.....	4494	54	22.3	.....	55	.....	.....	7.9	15	20	24	22	59.5	52.8	0.072	6.8
15	Aug. 16.....	No sample taken.	18.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.3
16	Sept. 6.....	4717	83	6.5	.....	54	.....	.....	7.5	2	10	.....	.....	63.2	.....	.....	9.4
17	27.....	4779	79	5.7	.....	49	.....	.....	7.7	2	9	.....	.....	61.3	.....	.....	9.5
18	Oct. 18.....	4823	90	12.5	.....	39	.....	.....	7.5	3	4	68	41	59.7	43.2	0.059	14.4
19	Nov.	No sample—river frozen.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.4
20	Dec. ....	“	“	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.6
21	Jan. /51.....	“	“	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.6
22	Average (6 samples)	61	.....	.....	.....	48	.....	.....	7.6	11	45	.....	.....	60.9	.....	.....	9.6

* Gauge height in feet.

TABLE II—Continued
 Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
 Coastal British Columbia
 (In parts per million)

Magnesium (Mg.)	Alkalies		Iron (Fe)		Sulphate (SO ₄)		Chloride (Cl)		Nitrate (NO ₃)		Fluoride (F)		Boron (B)		Bicarbonate (HCO ₃)		Carbonate (CO ₃)		Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents		Per cent sodium		Saturation index		No.
	Sodium (Na)	Potassium (K)	Total	Dissolved														Gravimetric	Colorimetric	Non-carbonate	Total			+	—				
0.5	1.3	0.9	3.9	0	22.0 (17.1)	0 (0)	2.7	0 (4.0)	15.6 (18.0)	25.5	1			

bridge near TERRACE, B.C.—Drainage area, 1,000 square miles (Continued)

0.8	1.1	1.0	1.4	0.26	4.9	0	0.9	0.10	.....	22.9	0	.....	.....	3.9	0	18.0	30.1	.....	.....	.....	.....	3
0.8	0.6	0.7	.....	.....	5.2	0	.....	.....	.....	22.0	0	.....	.....	4.4	0.8	18.8	28.7	.....	.....	.....	.....	4
1.1	2.4	1.2	.....	0.39	4.6	1.7	.....	.....	.....	34.2	0	.....	.....	4.4	0	27.2	41.8	.....	.....	.....	.....	5
0.9	1.3	0.9	.....	0.3	6.0	0	.....	.....	.....	24.8	0	.....	.....	4.3	1.6	21.6	33.4	11.2	.....	.....	1.9	7

RIVER from highway bridge near TERRACE, B.C.

1.5	0.9	0.7	4.8	0	0	26.8 (24.4)	0 (0)	6.8	3.1	25.1	36.9	6.2	1.6	8
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at NEW HAZELTON, B.C.

1.8	2.0	0.4	1.2	0.27	6.3	0	0.4	0	39.0	0	9.6	4.8	0.6	32.6	45.3	9
1.2	1.6	0.6	11.9	0.38	3.5	0	0	27.8	0	3.9	3.6	26.4	33.5	10
1.2	1.5	0.4	3.0	0.25	4.8	0.2	0	0.10	.....	32.2	0	10.0	7.8	1.7	28.1	41.5	.....	.....	.....	.....	11
1.1	1.6	0.3	.....	.....	5.3	0	.....	.....	-0.02	34.2	0	.....	7.8	0	28.0	42.3	.....	.....	.....	.....	12
1.0	1.1	0.4	.....	.....	6.2	0	.....	.....	.....	33.4	0	.....	3.3	0.4	27.8	38.0	.....	.....	.....	.....	13
1.2	1.5	0.3	0.39	0.02	2.9	0	0	0	.....	36.6	0	.....	0.8	1.0	31.0	35.1	.....	.....	.....	.....	14
1.3	1.6	0.4	.....	.....	4.8	0	.....	.....	.....	33.9	0	.....	4.7	1.2	29.0	39.3	10.5	.....	.....	1.3	15

TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in Coastal British Columbia

(In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second-feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Specific conductance K x 10 ⁶ at 25°C.	Residue on Evaporation at 105°C. (Dissolved solids)		Loss on ignition at 550°C.	Calcium (Ca)	
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.		P.P.M.	Tons per acre-foot	Tons per day X 10 ³		
1	Aug. 31/50.....	4571	42	58 (11.8) (1.5)	7.2 (7.4)	5 (5)	6 (7)	6.2	3.8	52.4	37.4	6.6	8.1

STATION No. 15: BULKLEY RIVER

1	Aug. 31/50.....	4571	42	58 (11.8) (1.5)	7.2 (7.4)	5 (5)	6 (7)	6.2	3.8	52.4	37.4	6.6	8.1
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STATION No. 16: BULKLEY RIVER at

2	Feb. 17/50.....	3965	15	980	917	33	7.8	5	0.3	69.2	10.6	
3	Mar. 16.....	4075	11	730	869	34	7.6	5	0.3	70.4	44.4	0.060	87	4.0	
4	April 17.....	4154	10	2,040	1,980	32	.....	7.6	5	0.5	.....	.....	.....	71.0	54.4	0.074	300	9.6
5	May 17.....	4277	32	9,640	7,220	40	.....	7.8	35	15	33	31	59.8	62.4	0.085	1,620	19.2	16.4
6	June 17.....	4408	40	19,200	15,100	51	.....	7.8	10	150	88	76	48.5	41.6	0.057	2,230	8.6	7.5
7	July 17.....	4500	56	7,320	7,830	54	7.1	10	0.3	54.6	48.0	0.065	943	9.2	7.9
8	Aug. 18.....	4720	102	4,800	4,680	59	.....	7.3	7	5	.....	.....	.....	50.5	.....	.....	.....	7.4
9	Sept. 18.....	4722	72	2,850	3,380	55	.....	8.0	1	3	.....	.....	.....	51.0	.....	.....	.....	7.6
10	Oct. 17.....	4824	91	2,280	2,220	40	.....	7.6	3	4	24	17	56.9	49.6	0.067	303	15.6	9.2
11	Nov. 17.....	4841	73	1,960	2,220	38	.....	7.4	5	0.6	.....	.....	.....	50.2	.....	.....	.....	7.9
12	Dec. 17/50.....	4879	52	1,600	1,740	38	.....	7.3	8	0.3	.....	.....	.....	60.4	.....	.....	.....	10.0
13	Jan. 17/51.....	4901	27	1,060	1,020	33	7.2	5	0.4	63.4	41.6	0.052	120	7.2	9.7
14	Average (12 samples)	48	4,539	4,098	42	.....	7.5	8	15	.....	.....	.....	58.4	48.9	0.067	800	.....	10.0

STATION No. 17: BULKLEY RIVER

15	Aug. 26/50.....	4783	130	61 (10.3) (2.0)	7.7 (7.9)	25 (25)	3	122	92.0	0.125	36.4	16.2
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STATION No. 18: TELKWA RIVER from

16	Aug. 31/50.....	4794	130	43	7.3 (3.0)	10 (8)	10 (10)	11	10	58.5	36.4	0.050	3.6	8.0
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STATION No. 19: MORICE

17	Aug. 31/50.....	4795	130	51 (1.5) (7.9)	7.5 (7.9)	0 (6)	3	55.5	42.6	0.058	4.0	7.9
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TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia
(In parts per million)

Magnesium (Mg.)	Alkalies		Iron (Fe)		Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Fluoride (F)	Boron (B)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents	Per cent sodium	Saturation index	No.
	Sodium (Na)	Potassium (K)	Total	Dissolved								Gravimetric	Colorimetric	Non-carbonate	Total				
												+	-						

from bridge at SMITHERS, B.C.

1.0	1.0	0.4	0.37	0.10	4.6	0	0	0.05	28.1 (24.4)	0 (0)	4.2	1.3 (8.0)	24.3 (28.0)	33.3	8.2	1.9	1
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QUICK, B.C.—Drainage area, 2,800 square miles.

1.3	1.4	0.3	4.1	0	0.35	0.05	38.6	0	5.4	0.3	31.9	42.5	2
1.7	1.6	0.2	.....	0.04	9.2	0	0	0	0.02	39.3	0	4.8	5.0	2.7	34.9	48.3	.....	.....	3
1.9	1.7	0.3	.....	0.06	13.8	0	0	0.10	.....	39.0	0	6.0	5.0	11.2	43.2	56.3	.....	.....	4
1.5	1.8	0.5	2.6	0.29	8.2	0	0.4	.....	.....	35.6	0	9.4	6.8	5.4	34.6	53.4	.....	.....	5
1.5	0.9	0.6	4.0	0.30	4.8	0	0.4	0.10	.....	26.4	0	.....	4.2	3.3	24.9	33.3	.....	.....	6
1.2	1.4	0.7	.....	0.54	2.9	0.2	2.2	0.05	.....	29.3	0	.....	4.5	0.6	24.6	36.0	.....	.....	7
0.9	0.8	0.3	.....	4.1	0	.....	.....	Tr.	26.6	0	.....	3.9	0.4	22.2	30.5	.....	.....	8	
0.8	1.1	0.2	.....	2.9	0	.....	.....	0	28.5	0	.....	5.0	0	22.3	31.6	.....	.....	9	
0.8	1.8	0.3	0.28	0.03	6.6	0	0	0	.....	31.7	0	.....	2.5	0.5	26.5	36.9	.....	.....	10
1.2	1.3	0.5	.....	2.7	0	.....	.....	0	29.3	0	.....	4.2	0.5	24.5	32.2	.....	.....	11	
1.1	1.5	0.3	.....	3.1	0	.....	.....	.....	36.4	0	.....	4.4	0	29.5	38.3	.....	.....	12	
1.3	1.4	0.2	.....	0.08	3.6	0	<0.4	0.05	.....	38.3	0	3.8	4.4	0	29.5	39.9	.....	.....	13
1.3	1.4	0.4	.....	0.19	5.5	0	0.62	.....	.....	33.3	0	.....	4.6	2.1	29.1	39.9	9.0	.....	14

from bridge below HOUSTON, B.C.

3.9	4.1	1.2	0.15	4.1	0	0.7	75.6 (75.6)	0 (0)	10.8	0	56.3	78.2	13.3	0.9	15
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bridge at mouth near TELKWA, B.C.

1.4	1.7	0.3	0.7	0.04	3.0	0	0	0.05	31.7	0	5.2	0	25.7	35.3	12.4	1.7	16
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RIVER near HOUSTON, B.C.

1.2	2.2	0.6	0.15	3.5	0	0	0	32.2 (24.0)	0 (0)	6.7	0 (3.0)	24.6 (23.0)	38.1	15.9	1.5	17
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TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in Coastal British Columbia

(In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second-feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Specific conductance $K \times 10^6$ at 25°C.	Residue on Evaporation at 105°C. (Dissolved solids)		Loss on ignition at 550°C.	Calcium (Ca)
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.		P.P.M.	Tons per acre-foot	Tons per day $\times 10^3$	
1	Aug. 16/49.....	3441	45	.....	63	.....	7.6 (1.0)	5 (8)	3	.....	.....	53.1	40.0	0.054	.....	16.8	10.0

VANCOUVER

STATION No. 1V: CAMPBELL RIVER

1	Aug. 16/49.....	3441	45	63	7.6 (1.0)	5 (8)	3	53.1	40.0	0.054	16.8	10.0
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STATION No. 2V: OYSTER

2	Aug. 16/49.....	3442	45	58	7.3 (1.7)	10 (9)	0.8 (clear)	38.7	34.0	0.046	15.0	6.6
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STATION No. 3V: TSOLUM

3	Aug. 16/49.....	3443	45	63	7.3 (1.5)	20 (10)	0.9 (slight)	38.3	35.0	0.048	17.0	4.6
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STATION No. 4V: BROWN'S

4	Aug. 16/49.....	3493	63	58	7.4 (1.0)	5 (7)	0.2	46.4	33.0	0.045	6.4	6.0
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STATION No. 5V: PUNTLEDGE

5	Aug. 16/49.....	3444	45	62	7.3 (2.5)	5 (5)	2 (slight)	56.1	41.6	0.057	18.6	10.0
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STATION No. 6V: LITTLE QUALICUM RIVER

6	Aug. 18/49.....	3395	22	61	7.5 (2.5)	0 (5)	2	84.5	14.0
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STATION No. 7V: ENGLISHMAN

7	Aug. 18/49.....	3396	23	58	7.3 (1.5)	5 (5)	2	86.1	11.5
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STATION No. 8V: CHINA CREEK

8	Aug. 17/49.....	3495	62	63	7.6 (1.5)	5 (10)	0.9	87.4	56.6	0.077	8.8	15.0
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TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia
(In parts per million)

Magnesium (Mg.)	Alkalies		Iron (Fe)		Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents	Per cent sodium	Saturation index + —	No.			
	Sodium (Na)	Potassium (K)	Total	Dissolved	Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Fluoride (F)	Boron (B)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Gravimetric	Colorimetric	Non-carbonate	Total
	(Mg.)	(Na)	(K)		(SO ₄)	(Cl)	(NO ₃)	(F)	(B)	(HCO ₃)	(CO ₃)				

ISLAND

near CAMPBELL RIVER, B.C.

0.9	1.1	0.2	0.11	7.5	0 (0)	0	0	29.9 (31.7)	0 (0)	4.8	4.2	28.7	39.3	7.7	1.3	1
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RIVER near mouth

. 0.8	1.3	0.3	0.04	6.2	0 (0)	0.35	0.05	19.9 (22.0)	0 (0)	6.0	3.5	19.8	31.4	12.4	2.0	2
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RIVER above COURtenay, B.C.

0.6	2.2	0.3	0.15	5.9	1.2	Trace	0	17.4 (19.5)	0 (0)	4.8	5.4	0	14.0	29.0	25.1	2.2	3
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RIVER at COURtenay, B.C.

1.2	1.4	0	0.03	3.3	0	0.6	0.05	25.4 (19.5)	0 (0)	5.8	5.2	0	19.9	30.2	13.3	1.9	4
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RIVER above COURtenay, B.C.

0.9	2.6	0.2	0.02	6.9	3.2	Trace	0	22.9 (22.0)	0 (0)	4.6	5.0	9.8	28.7	40.1	16.4	1.8	5
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(CAMERON LAKE) near QUALICUM BEACH, B.C.

1.2	1.8	0.2	4.9	0 (0)	48.8 (48.8)	0 (0)	5.0	0	39.8	51.2	8.9	1.2	6
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RIVER near PARKSVILLE, B.C.

0.8	5.3	0.1	6.1	0	27.1 (29.3)	0 (0)	5.8	9.8	32.0	42.9	26.4	7
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near PORT ALBERNI, B.C.

1.0	2.0	0	0.05	6.1	3.0	0	0.05	43.9 (46.4)	0 (0)	3.6	4.0	5.5	41.5	52.8	9.5	1.0	8
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TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in Coastal British Columbia

(In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second-feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Specific conductance $K \times 10^6$ at 25°C.	Residue on Evaporation at 105°C. (Dissolved solids)		Loss on ignition at 550°C.	Calcium (Ca)
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.	P.P.M.	Tons per acre-foot	Tons per day $\times 10^3$		
1	Aug. 18/49.....	3515	74	.....	.....	58	.....	.....	7.5 (3.0)	5 (7.7)	0.5 (clear)	.....	.....	109	70.0	0.045	9.8	17.6

STATION No. 9V: ROGER

1	Aug. 17/49.....	3514	75	68	7.4 (7.9)	3 (5)	0.6 (clear)	60.2	38.0	0.052	5.6	11.3
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STATION No. 10V: SPROAT

2	Aug. 17/49.....	3514	75	68	7.4 (7.9)	3 (5)	0.6 (clear)	60.2	38.0	0.052	5.6	11.3
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STATION No. 11V: GREAT CENTRAL

3	Aug. 17/49.....	3445	44	65	7.3 (1.5)	5 (7.8)	0.4 (5)	42.4	30.4	0.041	12.8	5.8
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STATION No. 12V: NANAIMO RIVER

4	Aug. 18/49.....	3378	19	63	7.0 (6.0)	15 (7.0)	2 (10)	55.6	37.0	0.050	10.8	5.9
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STATION No. 13V: STOCKING

5	Aug. 18/49.....	3516	74	64	7.4 (6.5)	5 (7.3)	0.9 (5)	31.7	27.0	0.037	7.8	5.4
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STATION No. 14V: CHEMAINUS

6	Aug. 19/49.....	3379	18	59	7.3 (2.0)	4 (7.5)	0.7 (5)	62.1	38.0	0.052	7.8	7.5
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STATION No. 15V: COWICHAN

7	Aug. 19/49.....	3380	18	63	7.8 (0.8)	5 (8.1)	1 (7)	70.0	41.0	0.056	13.0	9.5
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STATION No. 16V: KOKSILAH

8	Aug. 19/49.....	3397	22	57	7.8 (7.3)	7 (8)	0.9 (8)	131	19.0
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TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia
(In parts per million)

Magnesium (Mg.)	Alkalies		Iron (Fe)		Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Fluoride (F)	Boron (B)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents	Per cent sodium	Saturation index	No.
	Sodium (Na)	Potassium (K)	Total	Dissolved								Gravimetric	Colorimetric	Non-carbonate	Total				

CREEK near ALBERNI, B.C.

1.3	3.5	0.1	0.03	4.3	7.2	Trace	0	55.2 (56.1)	0 (0)	6.2	4.1	49.3	67.3	13.3	1.0	1
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RIVER near ALBERNI, B.C.

0.6	1.1	0.1	0.04	3.5	2.1	0	0	35.4 (30.5)	0 (0)	2.0	3.2	1.7	30.7	39.3	7.2	1.4	2
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LAKE near ALBERNI, B.C.

0.3	1.1	0.1	Trace	1.3	0 (0)	0	0.05	18.9 (19.5)	0 (0)	3.4	4.4	0.2	15.7	22.3	13.1	2.1	3
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(SOUTH FORK) near NANAIMO, B.C.

0.4	2.6	0.2	0.56	6.6	2.3	0	0	17.6 (19.5)	0 (0)	3.4	4.9	1.9	16.3	32.0	25.3	2.4	4
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LAKE near LADYSMITH, B.C.

0.8	1.3	0.2	0.06	6.6	0.7	0	0	18.3 (19.5)	0 (0)	4.6	1.8	16.8	28.6	14.3	2.0	5
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RIVER near CHEMAINUS, B.C.

0.8	2.4	0.3	0.02	6.2	3.1	0	0.05	24.4 (26.8)	0 (0)	6.6	2.0	22.0	38.9	18.8	1.9	6
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RIVER near DUNCAN, B.C.

1.0	2.0	0.3	0.03	7.6	0 (0)	0	0	29.3 (31.0)	0 (0)	4.8	4.0	27.8	39.6	13.4	1.2	7
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RIVER near DUNCAN, B.C.

2.3	4.2	0.3	12.4	0	58.3 (59.8)	0 (0)	8.8	9.1	56.9	75.7	13.8	0.6	8
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TABLE II—Continued
 Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
 Coastal British Columbia
 (In parts per million)

No.	Date of collection	Sample No.	Storage period (Days)	Stream discharge (Second-feet)		Water temperature (°F.)	Dissolved oxygen	Carbon dioxide	pH	Colour	Turbidity	Suspended matter		Residue on Evaporation at 105°C. (Dissolved solids)			Loss on ignition at 550°C.	Calcium (Ca)
				On sampling date	Monthly mean							Dried at 105°C.	Ignited at 550°C.	P.P.M.	Tons per acre-foot	Tons per day $\times 10^3$		

STATION NO. 17V: SHAWINIGAN LAKE

1	Aug. 19/49....	3518	73	66	7.1	10	0.8	46.4	34.2	0.047	13.8	6.0
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STATION NO. 18V: GOLDSTREAM

2	Aug. 12/49....	3392	25	66	6.9	10	1	31.2	21.6	0.029	8.4	3.2
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*Probable iron pickup from pipes as sample taken from tap at Langford, B.C.

STATION NO. 19V: SOOKE

3	Aug. 12/49....	3359	12	63	7.4	5	2	57.5	26.0	0.049	13.8	5.8
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3. COASTAL BRITISH

STATION NO. 1C: STAWAMUS

4	Jan. 3/51....	4969	30	45	7.6	7	0.5	54.2	38.2	0.052	8.2	5.5
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STATION NO. 2C: BRITANNIA CREEK

5	Jan. 21/51....	5153	25	45	6.8	5	0.3	8.1	1.4
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STATION NO. 3C: TROUT LAKE

6	Feb. 8/51....	4934	35	46	7.0	2	3	47.4	41.2	0.056	12.8	6.0
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STATION NO. 4C: CHAPMAN

7	Feb. 9/51....	4933	34	6.6	45	0.7	17.0	26.0	0.036	13.0	2.6
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STATION NO. 5C: WEST

8	Mar. 2/51....	4967	29	35	7.3	7	0.5	30.3	22.4	0.031	12.0	2.3
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STATION NO. 6C: POWELL RIVER

9	Mar. 2/51....	4968	29	6.8	5	0.4	22.0	16.6	0.023	8.6	1.8
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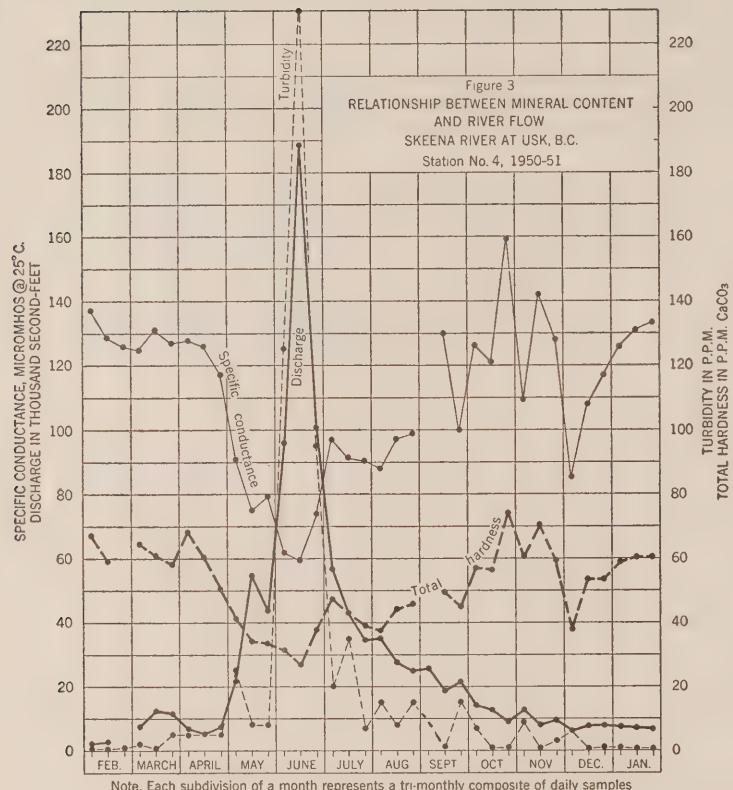
STATION NO. 7C: LINK LAKE

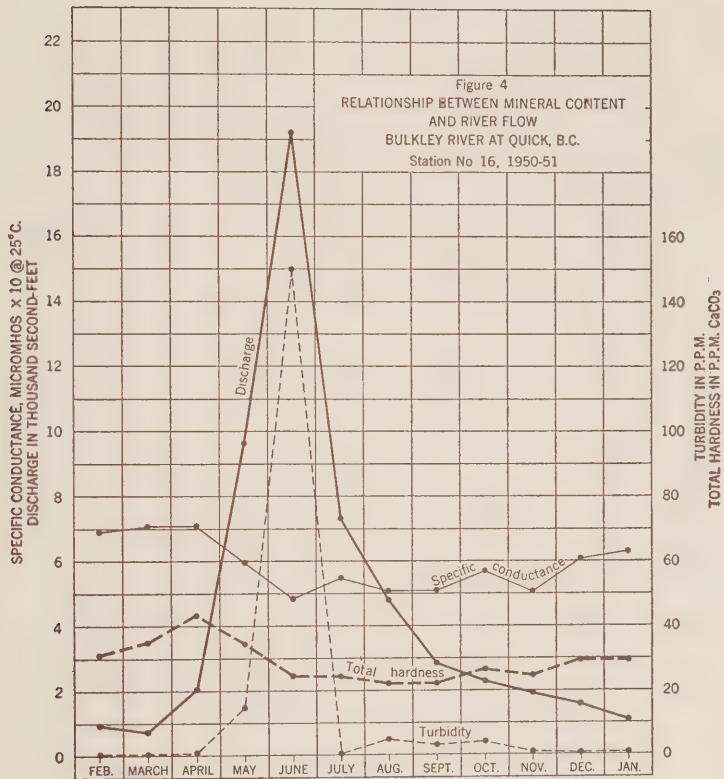
10	Feb. 22/51....	4938	21	38	7.5	10	3	15.2	13.6	0.019	6.0	0.8
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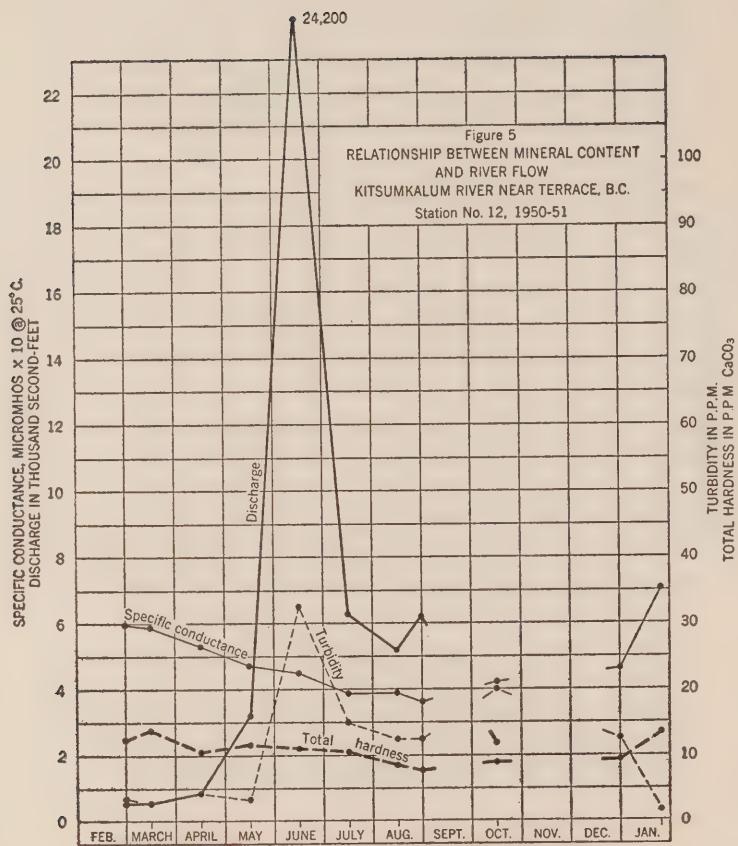
TABLE II—Continued

Chemical Analysis of Surface Waters in the Skeena River Drainage Basin, on Vancouver Island, and in
Coastal British Columbia
(In parts per million)

Magnesium (Mg.)	Alkalies			Iron (Fe)		Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Fluoride (F)	Boron (B)	Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Silica (SiO ₂)		Hardness as CaCO ₃		Sum of Constituents	Per cent sodium	Saturation Index No.
	Sodium (Na)	Potassium (K)	Total	Dissolved	Gravimetric	Colorimetric	Non-carbonate	Total											
near SHAWINIGAN LAKE, B.C.																			
1.0	2.0	0.1	.....	0.04	4.3	3.5	Trace	0	.....	22.0 (24.4)	0 (0)	3.6	4.4	19.1	46.4	32.1	18.4	.....	2.0 1
LAKE near VICTORIA, B.C.																			
0.6	2.0	0.3	.....	0.37*	1.6	2.3	Trace	0	.....	12.9 (13.4)	0 (0)	2.6	2.8	0	10.5 (11.5)	19.4	28.6	.....	2.0 2
LAKE near VICTORIA, B.C.																			
1.7	1.6	0.3	.....	0.09	4.0	2.4	0	0	.....	23.9 (24.4)	0 (0)	3.6	4.6	1.9	21.5	32.1	13.9	.....	1.9 3
COLUMBIA																			
RIVER near SQUAMISH, B.C.																			
0.8	1.4	0.2	.....	0.03	10.7	0.7	0.4	.....	.....	10.7	0	.....	7.7	8.2	17.0	32.7	15.0	.....	2.1 4
near BRITANNIA BEACH, B.C.																			
0.2	0.3	0.1	.....	.....	0.5	0.6	0.3	0	.....	4.9	0	.....	1.9	0.3	4.3	7.7	12.7	.....	3.7 5
at BOWEN ISLAND, B.C.																			
0.9	1.7	0.2	.....	0.19	4.9	2.0	3.5	0	.....	17.1	0	6.4	7.0	4.7	18.7	51.8	16.3	.....	2.5 6
CREEK at SECHELT, B.C.																			
0.2	0.4	0.2	.....	0.22	1.5	0	0.5	.....	.....	9.8	0	5.6	2.8	0	7.3	13.2	10.3	.....	3.5 7
LAKE at WESTVIEW, B.C.																			
0.6	2.4	0.4	.....	0.02	2.6	3.9	Trace	0	.....	8.8	0	.....	1.8	1.0	8.2	18.3	37.5	.....	2.9 8
at POWELL RIVER, B.C.																			
0.3	1.9	0.2	.....	0.01	4.3	3.6	0.4	0	.....	4.9	0	.....	2.5	1.7	5.7	17.4	40.8	.....	3.6 9
at OCEAN FALLS, B.C.																			
0.3	0.4	0.2	.....	0.04	1.0	0.5	0.6	0	.....	2.4	0	3.4	1.9	1.2	3.2	6.8	20.0	.....	3.5 10







DISCUSSION

It is not proposed at this time to discuss in any detail the data reported in Table II. It is noted, however, that the surface waters of all three areas are very similar in character, being soft to border-line medium hard, using the following classification:

Soft water.....	Below 60 p.p.m. total hardness as CaCO_3
Medium hard water.....	61 to 120 p.p.m. total hardness as CaCO_3
Hard water.....	121 to 180 p.p.m. total hardness as CaCO_3
Very hard water.....	Greater than 180 p.p.m. total hardness as CaCO_3

These river waters do not show any wide variation in hardness classification from season to season. Many have a high colour and are typical of waters rising in wooded, relatively insoluble terrain. They differ little from waters from the Precambrian shield of northern Ontario (Water Survey Report No. 2). Many of the very short coastal rivers are extremely soft with very little mineralization. Spray from the Pacific Ocean, carried by the winds, gives rise to an increase in chlorides in many coastal waters.

Figure 2 shows graphically a decrease in the hardness of Skeena River water as it approaches the sea or until the tidal effect is observed. The reason for this, indicated in Figure 2, is that the waters of tributaries, such as the Bulkley River, rising at a considerable distance from the coast, are harder than the shorter, coastal tributary streams. Moisture-laden winds from the Pacific cause heavy rainfall on the wooded coastal range. The short length of the streams and brief contact with the soil causes little pick-up of soluble constituents from the soil and thus an abundance of very soft water enters the main river in its lower reaches.

Figure 3 shows that the total mineralization and hardness of Skeena River is directly related to discharge, these decreasing about one-half the normal value when the river is in flood and the discharge is about eighty times greater. The curve of turbidity follows closely the discharge curve. These relationships are as expected, considering the terrain and the heavy rainfall and snowfall. In the spring and early summer melting snow and heavy rains feed the rivers with a very soft, low-mineralized water, causing a decrease in hardness and specific conductance. Since this spring run-off is heavy and rapid it does pick up considerable suspended matter, causing a marked increase in turbidity.

Figures 4 and 5, which show the relationship between discharge and mineral content in Kitsumkalum River and Bulkley River respectively, are almost identical curves to that of Figure 3 for Skeena River. In Kitsumkalum River the changes are somewhat more gradual; about a fiftyfold increase in discharge is coincident with about a twentyfold increase in turbidity, while hardness decreases about one-half.

In Bulkley River, at Quick, discharge and turbidity increase in the spring about fortyfold and a hundred and fiftyfold respectively, while hardness and specific conductance do not show as marked a variation as found on Skeena and Kitsumkalum Rivers.

A similar graphical study of Bulkley River at New Hazelton shows that the general relationship between mineral content, turbidity, and discharge is almost identical with the curves of Figures 3, 4, and 5.

SUMMARY

It is evident from Table II that surface waters in the Skeena River basin are generally similar in character, being soft to medium-hard, with considerable colour at times.

Surface waters of Vancouver Island and the coastal region are similar in character and generally softer and more consistent in nature than those of the Skeena River system, because the rivers are usually shorter and the rainfall heavy and fairly constant throughout the year.

Surface waters of the entire area covered by this report are, therefore, very satisfactory for industrial use. The main problem would be the slightly acid nature of many of the waters, due to a high content of free carbon dioxide and/or organic acid, the high colour in some, and the high turbidity noted in other river waters for a short period. Since many of the rivers and lakes rise in unpopulated, mountainous country their waters are available to industry by gravity, with no cost for pumping and treatment.

It is believed that owing to the constancy of the terrain, rainfall, etc., surface waters along the coast and on the islands that were not studied in this survey can generally be assumed to be similar in chemical character to those herein reported.

PART II

MUNICIPAL WATERS WITHIN THE SKEENA RIVER DRAINAGE BASIN, ON VANCOUVER ISLAND, AND IN COASTAL BRITISH COLUMBIA

When survey studies of the surface waters in these areas were being carried out with the mobile laboratory most of the municipalities having organized water systems were visited, and information on the operation of the systems and samples of the civic waters obtained. Many of the civic water supplies are untreated or chlorinated surface waters and these have also been reported in Table II, Part I.

Information on the systems and samples of civic waters in municipalities in coastal British Columbia which are inaccessible by highway, were obtained through the co-operation of municipal officials.

Information on municipal water systems is given below under the headings: population, ownership, source, treatment, storage capacity, water consumption, and industrial use.

The chemical quality of the civic waters studied is reported in Table III. Sum of constituents and saturation index have also been reported in this table. The interpretation of these and other values is discussed in Water Survey Report No. 1¹.

The municipalities studied are listed in Appendix B, and their locations are shown in Figure 1 in such a manner that the water hardness of their supplies is also classified.

Table IV is a summary of the information available on the municipal waters as regards area studied, total area population, and population served with water.

Table V is a summary of the information on municipal waters as regards the number of systems and the source, treatment, and hardness of the civic waters.

¹ Ibid.

TABLE III
Chemical Analyses of Civic Water Supplies
1. SKEENA RIVER DRAINAGE BASIN, B.C.
(*In parts per million*)

Municipality.....	PRINCE RUPERT	SMITHERS	TERRACE
Source(s).....	Woodworth Lake	Bulkley River	Springs
	Raw and finished water	Raw and finished water	Raw and finished water
Sampling point.....	Town tap	Direct from river	Town tap
 Laboratory No.....	4803	4571	4811
Field No.....	747	761	757
Date of collection.....	Aug. 28/50	Aug. 31/50	Aug. 29/50
Storage period (days).....	58	42	139
Sampling temperature, °C.....	16.6	11.4	13.3
Test temperature, °C.....	23.0 (17.0)	21.5 (12.8) (11.8)	21.0 (14.2)
Dissolved oxygen.....	(1.3)	(1.5)	(19.0)
Carbon dioxide (CO ₂).....	7.5 (7.0)	7.2 (7.4)	6.9 (6.8)
pH.....	15 (40)	5 (5)	3 (<5)
Colour.....	0.2 (clear)	6 (7)	1 (clear)
Turbidity.....		6.2	
Suspended matter, dried at 105°C.....		3.8	
Suspended matter, ignited at 550°C.....			
Residue on evaporation, dried at 105°C.....	27.4	37.4	71.6
Ignition loss at 550°C.....	10.4	6.6	7.4
Specific conductance (micromhos at 25°C.).....	28.2	52.4	104
Calcium (Ca).....	4.9	8.1	14.1
Magnesium (Mg).....	0.1	1.0	2.1
Iron (Fe) Total.....		0.37	
Dissolved.....	0.17	0.10	0.10
Sodium (Na).....	1.1	1.0	3.9
Potassium (K).....	0.2	0.4	1.2
Carbonate (CO ₃).....	0 (0)	0 (0)	0 (0)
Bicarbonate (HCO ₃).....	12.0 (11.0)	23.1 (24.4)	58.6 (54.9)
Sulphate (SO ₄).....	3.8	4.6	4.6
Chloride (Cl).....	0	0	0
Fluoride (F).....	0.2	0.05	0.11
Nitrate (NO ₃).....	0	0	3.5
Silica (SiO ₂) Gravimetric.....	2.0		9.6
Colorimetric.....	2.0	4.2	11.6
Carbonate hardness, as CaCO ₃ , p.p.m.....	9.8 (9.0)	23.0 (20.0)	43.8
Non-carbonate hardness, as CaCO ₃ , p.p.m.....	12.7 (12.0)	1.3 (8.0)	0
Total carbonate hardness, as CaCO ₃ , p.p.m.....	21.5 (21.0)	24.3 (23.0)	43.8
Saturation index.....	-2.1	-1.9	-1.6
Sum of constituents.....	18.3	33.2	70.4
 Remarks:			

TABLE III—Continued
 Chemical Analyses of Civic Water Supplies—Continued
 2. VANCOUVER ISLAND AREA, B.C.
(In parts per million)

Municipality.....	ALBERNI	CAMPBELL RIVER	CHEMAINUS	COLWOOD	COMOX	COURTENAY	CUMBERLAND	DUNCAN
Source(s).....	Roger Creek	Campbell River (Elk Lake)	Fullers Lake and Miller Creek	Supplied by Greater Victoria Water Board	Supplied by Courtenay, B.C.	Brown's River	Mountain streams including Hamilton Creek	Cowichan River
	Raw and finished water	Raw and finished water	Raw and finished water			Raw and finished water	Raw and finished water	Raw and finished water
Sampling point.....	Town tap	From river near Elk Lake	Town tap	—	—	Town tap	Town tap	From river at highway bridge.
Laboratory No.....	3515	3492	3517			3493	3494	3380
Field No.....	489	480	404			484	485	497
Date of collection.....	Aug. 18/49	Aug. 16/49	Aug. 19/49			Aug. 16/49	Aug. 16/49	Aug. 19/49
Storage period (days).....	74	63	73			63	63	18
Sampling temperature, °C.....	14.5	17.0	19.0			14.5	15	17.0
Test temperature, °C.....	20.8	22.0	20.4			22.0	22.0	21.5 (18.6)
Dissolved oxygen.....	(3.0)		(8.9)			(1.0)		(0.8)
Carbon dioxide (CO ₂).....	7.5 (7.7)	7.5 (7.6)	6.9 (6.3)	See Victoria, B.C.	See Courtenay, B.C.	7.4 (7.7)	7.4 (7.5)	7.8 (8.1)
pH.....	5	3	7 (5)			5 (7)	10 (18)	5 (7)
Colour.....	0.5	2	0.5			0.2	0.5	1 (clear)
Turbidity.....								
Suspended matter, dried at 105°C.....								
Suspended matter, ignited at 550°C.....								
Residue on evaporation, dried at 105°C.....	70.0	41.6	32.2			33.0	30.2	41.0
Ignition loss at 550°C.....	9.8	7.4	15.4			6.4	9.6	13.0
Specific conductance (micromhos at 25°C).....	109	58.1	34.6			46.4	34.4	70.0
Calcium (Ca).....	17.8	8.0	4.8			6.0	4.0	9.5
Magnesium (Mg).....	1.3	1.6	0.6			1.2	1.3	1.0
Iron (Fe) Total.....							0	
Dissolved.....	0.03	0	0.07			0.03		0.03
Sodium (Na).....	3.5	1.4	1.3			1.4	1.1	2.0
Potassium (K).....	0.1	0	0.4			0	0	0.3
Carbonate (CO ₃).....	0 (0)	0 (0)	0 (0)			0 (0)	0 (0)	0 (0)
Bicarbonate (HCO ₃).....	55.2 (56.1)	31.1 (30.5)	8.3 (7.3)			25.4 (19.5)	18.3 (18.3)	29.3 (31.0)
Sulphate (SO ₄).....	4.3	2.8	3.1			3.3	2.0	7.6
Chloride (Cl).....	7.2	0.1	1.7			0	0 (0)	0 (0)
Fluoride (F).....	0	0.05	0.10			0.05	0.10	0
Nitrate (NO ₃).....	Trace	Trace	10.6			0.6	0.5	0
Silica (SiO ₂) Gravimetric.....		5.4	2.4			5.8	3.6	
Colorimetric.....	6.2	5.8	3.6			5.2	4.0	4.8
Carbonate hardness, as CaCO ₃ , p.p.m.....	45.2 (46.0)	25.5 (25.0)	6.8 (6.0)			19.9 (16.0)	15.0 (15.0)	23.8 (25.0)
Non-carbonate hardness, as CaCO ₃ , p.p.m.....	4.1	1.1	7.7			0	0.4	4.0
Total carbonate hardness, as CaCO ₃ , p.p.m.....	49.3	26.6	14.5			19.9	15.4	27.8
Saturation index.....	-1.1	-1.6	-3.0			-1.9	-2.2	-1.9
Sum of constituents.....	67.3	35.0	30.2			30.2	22.0	39.6
Remarks:	Roger Creek is fed by Copper Creek and Yellowstone Creek, principally the latter.		Miller Creek flows into Fullers Lake. Note corrosive index.				This town is in a coal mining area.	

TABLE III—*Continued*
Chemical Analyses of Civic Water Supplies—Continued
2. VANCOUVER ISLAND AREA, B.C.—Continued
(In parts per million)

Municipality.....	ESQUIMALT	ESQUIMALT DISTRICT MUNICIPALITY	GREATER VICTORIA WATER BOARD	LADYSMITH	LAKE COWICHAN	LANGFORD	NANAIMO	NORTH COWICHAN MUNICIPALITY
Source(s).....	Supplied by Greater Victoria Water Board	Supplied by Greater Victoria Water Board	Sooke and Goldstream Lakes	Stocking Lake	Stanley Creek	Supplied by Greater Victoria Water Board	Nanaimo River	Mountain Creeks
			Raw and finished water				Raw and finished water	
Sampling point.....				Town tap			Town tap	
Laboratory No.....				3516			3378	
Field No.....				493			492	
Date of collection.....				Aug. 18/49			Aug. 18/49	
Storage period (days).....				74			19	
Sampling temperature, °C.....				18.0			17.5	
Test temperature, °C.....				20.7			21.8	
Dissolved oxygen.....				(6.5)			(6.0)	
Carbon dioxide (CO ₂).....				7.4 (7.3)			7.0 (7.0)	
pH.....				5 (5)			15.0 (10)	
Colour.....				0.9 (sl.)			2 (sl.)	
Turbidity.....								
Suspended matter, dried at 105°C.....								
Suspended matter, ignited at 550°C.....								
Residue on evaporation, dried at 105°C.....								
Ignition loss at 550°C.....	See Victoria, B.C.	See Victoria, B.C.	See Victoria, B.C.	27.0			37.0	
Specific conductance (micromhos at 25°C).....				7.8	No information	See Victoria, B.C.	10.8	System still under construction in Aug. /49.
Calcium (Ca).....				31.7			55.6	
Magnesium (Mg).....				5.4			5.9	
Iron (Fe) Total.....				0.8			0.4	
Dissolved.....								
Sodium (Na).....				0.06			0.56	
Potassium (K).....				1.3			2.6	
Carbonate (CO ₃).....				0.2			0.2	
Bicarbonate (HCO ₃).....				0 (0)			0 (0)	
Sulphate (SO ₄).....				18.3 (19.5)			17.6 (19.5)	
Chloride (Cl).....				6.6			6.6	
Fluoride (F).....				0.7			2.3 (3.8)	
Nitrate (NO ₃).....				0			0	
Silica (SiO ₂) Gravimetric.....				0			0	
Colorimetric.....				4.6			3.4	
Carbonate hardness, as CaCO ₃ , p.p.m.....				15.0 (16.0)			14.4 (16.0)	
Non-carbonate hardness, as CaCO ₃ , p.p.m.....				1.8			1.9	
Total carbonate hardness, as CaCO ₃ , p.p.m.....				16.8			16.3	
Saturation index.....				-2.1			-2.5	
Sum of constituents.....				28.6			32.0	
Remarks:								

TABLE III—Continued
 Chemical Analyses of Civic Water Supplies—Continued
 2. VANCOUVER ISLAND AREA, B.C.—Continued
 (In parts per million)

Municipality.....	OAK BAY*	PARKSVILLE	PORT ALBERNI	QUALICUM BEACH	ROYSTON	SAANICH DISTRICT MUNICIPALITY	SANDWICK	SASEENOS
Source(s).....	Supplied by Greater Victoria Water Board	Spring	China Creek	Little Qualicum River (Whisky Creek)	Raw and finished water	Supplied by Courtenay, B.C.	Purchased from Victoria Water Board; one well	Supplied by Courtenay, B.C.
Sampling point.....		Analyses supplied by municipality	Town tap	At outlet of Cameron Lake				Supplied by Greater Victoria Water Board
Laboratory No.....			3495	3395				
Field No.....			486	490				
Date of collection.....		1945-1946*	Aug. 17/49	Aug. 18/49				
Storage period (days).....			62	22				
Sampling temperature, °C.....			17.5	16.0				
Test temperature, °C.....			22.0	22.0				
Dissolved oxygen.....			(1.5)	(2.5)				
Carbon dioxide (CO ₂).....			7.3	7.6 (8.0)	7.5 (8.0)			
pH.....		0.4	Trace	5 (10)	0 (5)			
Colour.....				0.9	2.4			
Turbidity.....								
Suspended matter, dried at 105°C.....								
Suspended matter, ignited at 550°C.....								
Residue on evaporation, dried at 105°C.....		142	56.6					
Ignition loss at 550°C.....	See Victoria, B.C.		8.8			See Courtenay, B.C.	See Victoria, B.C.	See Courtenay, B.C.
Specific conductance (micromhos at 25°C.).....			82.4	87.4				
Calcium (Ca).....			15.0	14.0				
Magnesium (Mg).....			1.0	1.2				
Iron (Fe) Total.....								
Dissolved.....			0.05					
Sodium (Na).....			2.0	1.8				
Potassium (K).....			0	0.2				
Carbonate (CO ₃).....			0 (0)	0 (0)				
Bicarbonate (HCO ₃).....			43.9 (46.4)	48.8 (48.8)				
Sulphate (SO ₄).....			6.1	4.9				
Chloride (Cl).....		0.2	3.0	0 (0)				
Fluoride (F).....			0.05					
Nitrate (NO ₃).....		0.06	0					
Silica (SiO ₂) Gravimetric.....			3.6					
Colorimetric.....			4.0	5.0				
Carbonate hardness, as CaCO ₃ , p.p.m.....			36.0 (38.0)	39.8 (40.0)				
Non-carbonate hardness, as CaCO ₃ , p.p.m.....			5.5	0				
Total carbonate hardness, as CaCO ₃ , p.p.m.....		108	41.5	39.8				
Saturation index.....			(Free NH ₃ —0.015 p.p.m.)	-1.1	-1.2			
Sum of constituents.....			52.8	51.2				
Remarks:	*A district Municipality.	* Analyses by Armstrong Laboratories, Vancouver.				No record on well water.		

TABLE III—Continued
 Chemical Analyses of Civic Water Supplies—Continued
 2. VANCOUVER ISLAND AREA, B.C.—Continued
 (In parts per million)

Municipality.....	SHAWINIGAN LAKE	SIDNEY		SOOKE	VICTORIA	
Source(s).....	Shawinigan Lake	Wells Nos. 1 and 2	Spring	Supplied by Greater Victoria Water Board	Sooke Lake	Goldstream Lake
Sampling point.....	Raw and finished water	Raw and finished water			Raw and finished water	
	Direct from lake	Direct from pump	From pipe at spring		City tap	City tap near Langford
Laboratory No.....	3518	3519	3381		3359	3392
Field No.....	498	499	500		477	478
Date of collection.....	Aug. 19/49	Aug. 20/49	Aug. 20/49		July 12/49	Aug. 12/49
Storage period (days).....	73	72	17		12	25
Sampling temperature, °C.....	19	11.0	10.5		20.0	19.0
Test temperature, °C.....	20.3	20.5	21.7		23.0	21.1
Dissolved oxygen.....						
Carbon dioxide (CO ₂).....	(2.5)				(2.0)	(3.5)
pH.....	7.1 (7.9)	7.5 (6.7)	6.8 (6.3)		7.4 (7.6)	6.9 (7.3)
Colour.....	10 (15)	3 (3)	0 (3)		5 (10)	10 (20)
Turbidity.....	0.8 (algae)	0.6	0.5		2	1
Suspended matter, dried at 105°C.....				See Victoria, B.C.		
Suspended matter, ignited at 550°C.....						
Residue on evaporation, dried at 105°C.....	34.2	130	102		36.0	21.6
Ignition loss at 550°C.....	13.8	37.6	21.4		13.8	8.4
Specific conductance (micromhos at 25°C.).....	46.4	184	154		57.5	31.2
Calcium (Ca).....	6.0	17.0	16.4		5.8	3.2
Magnesium (Mg).....	1.0	5.4	4.0		1.7	0.6
Iron (Fe) Total.....						
Dissolved.....	0.04	0.02	0.02		0.09	0.37
Sodium (Na).....	2.0	10.0	6.4		1.6	2.0
Potassium (K).....	0.1	0.9	0.4		0.3	0.3
Carbonate (CO ₃).....	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)
Bicarbonate (HCO ₃).....	22.0 (24.4)	69.6 (70.8)	63.4 (66.4)		23.9 (24.4)	12.9 (13.4)
Sulphate (SO ₄).....	4.3	10.5	10.9		4.0	1.6
Chloride (Cl).....	3.5	13.6 (13.6)	2.6		2.4 (2.0)	2.3
Fluoride (F).....	0	0.05	0.05		0	0
Nitrate (NO ₃).....	Trace	14.2	0		0	Trace
Silica (SiO ₂) Gravimetric.....	3.6	18			3.6	2.6
Colorimetric.....	4.4	18	20		4.6	2.8
Carbonate hardness, as CaCO ₃ , p.p.m.....	18.0 (20.0)	57.0 (58.0)	51.8 (54.4)		19.6 (20.0)	10.5 (11.0)
Non-carbonate hardness, as CaCO ₃ , p.p.m.....	1.1	24.8	5.6		1.9	0 (0.5)
Total carbonate hardness, as CaCO ₃ , p.p.m.....	19.1	81.8	57.4		21.5	10.5 (11.5)
Saturation index.....	-2.4	-1.8	-0.97		-1.7	-3.0
Sum of constituents.....	32.1	125	91.9		32.1	19.4
Remarks:					Note high iron in No. 478 compared with No. 477. This may be due to iron pickup in system even though water ran 5 minutes prior to sampling.	

TABLE III—Continued
 Chemical Analyses of Civic Water Supplies—Continued
 3. COASTAL BRITISH COLUMBIA
(In parts per million)

Municipality.....	BOWEN ISLAND	BRITANNIA BEACH			CRAN-BERRY LAKE	GIBSONS LANDING	
Source(s).....	Trout Lake	Britannia Creek and tributaries			Powell River	Spring	
Sampling point.....	Raw and finished water	Raw and finished water			Raw and finished water	Raw and finished water	
	Town tap	Britannia Creek (at Park Lane Dam)	small tributary creek* (at townsite tap)	at Beach Power House	mixed supply town tap	Lower spring	Upper spring
Laboratory No.....	4934	5153	5152	5154	5155	5103	5104
Field No.....	788	805	804	806	807	871	872
Date of collection.....	Feb. 8/51	June 21/51	June 21/51	June 27/51	June 27/51	Apr. 25/51	Apr. 25/51
Storage period (days).....	35	25	25	19	19	45	45
Sampling temperature, °C.....	7.8	7.2	8.3	7.2	10.0	7.8	11.1
Test temperature, °C.....	20	27.5	27.5	27.5	27.5	22.0	22.0
Dissolved oxygen.....							
Carbon dioxide (CO ₂).....						7.2	6.9
pH.....	7.0	6.8	7.1	6.8	7.2	3	5
Colour.....	20	5	5	5	7	0.7	2
Turbidity.....	3	0.3	0.3	0.3	0.3		
Suspended matter, dried at 105°C.....							
Suspended matter, ignited at 550°C.....							
Residue on evaporation, dried at 105°C.....	41.2				27.8	Water supplied by Powell River	91.0
Ignition loss at 550°C.....	12.8				8.0	Co. Ltd. (See	20.2
Specific conductance (micromhos at 25°C.).....	47.4	8.1	10.2	16.6	38.8	Powell River,	83.5
Calcium (Ca).....	6.0	1.4	1.6	2.6	7.1	B.C.).	5.7
Magnesium (Mg).....	0.9	0.2	0.3	0.2	0.3		4.9
Iron (Fe) Total.....							3.2
Dissolved.....	0.19				0.12		1.2
Sodium (Na).....	1.7	0.3	0.3	0.4	0.6	0.03	0.08
Potassium (K).....	0.2	0.1	0.1	0.1	0.1	5.5	3.3
Carbonate (CO ₃).....	0	0	0	0	0	2.0	0.7
Bicarbonate (HCO ₃).....	17.1	4.9	4.9	6.8	22.4	0	0
Sulphate (SO ₄).....	4.9	0.5	0.5	2.7	3.1	40.3	23.9
Chloride (Cl).....	2.0	0.6	0.4	0.8	0.3	4.8	2.1
Fluoride (F).....	0	0	0	0	0.05	3.4	2.4
Nitrate (NO ₃).....	3.5	0.26	0.2	0.4	0.16	0.1	0.2
Silica (SiO ₂) Gravimetric.....	6.4					0.4	0
Colorimetric.....	7.0	1.9	1.8	2.8	3.4	39	16.0
Carbonate hardness, as CaCO ₃ , p.p.m.....	14.0	4.0	4.0	5.6	18.4	27.4	17.2
Non-carbonate hardness, as CaCO ₃ , p.p.m.....	4.7	0.3	1.2	1.7	0.6	0	0
Total carbonate hardness, as CaCO ₃ , p.p.m.....	18.7	4.3	5.2	7.3	19.0	27.4	17.2
Saturation index.....	-2.5	-3.7	-3.3	-3.3	-2.0	-3.0	-2.5
Sum of constituents.....	51.8	7.7	7.7	13.4	26.5	83.9	42.5
Remarks:		* Probably Marmot Creek. Note corrosiveness as indicated by saturation index. There are many small creeks in same locality as Britannia Creek, or tributary to it, including Jane Creek, Furry Creek, Cyrtina Creek, etc. Recent field studies of these waters for copper and zinc showed Jane Creek to have 270 to 3,000 p.p.m. copper and 2,000 to 9,000 p.p.m. zinc. Britannia Creek above Jane Creek showed about 5 p.p.m. copper; Furry Creek also about 5 p.p.m. copper. These heavy metal contents are due to mining and smelting in the area. (Harry V. Warren, Robert E. Delavault and Ruth J. Irish, Bulletin of the Geological Society of America, vol. 62, pp. 614-616, 1951).					

TABLE III—Continued
 Chemical Analyses of Civic Water Supplies—Continued
 3. COASTAL BRITISH COLUMBIA—Continued
 (In parts per million)

Municipality.....	OCEAN FALLS			POWELL RIVER	SECHELT	SQUAMISH	WESTVIEW	
Source(s).....	Link Lake			Powell River	Chapman Creek	Stawamus River	Springs	West Lake
	Raw and finished water			Raw and finished water	Raw and finished water	Raw and finished water			Raw and finished water
Sampling point.....			Town tap	Town tap	Town tap	Town tap	Town tap	Town tap
Laboratory No.....			4938	4968	4933	4969	4966	4967
Field No.....			792	799	787	800	797	798
Date of collection.....	Sept. 27/50*	Nov. 14/50*	Feb. 22/51	Mar. 2/51	Feb. 9/51	Mar. 1/51	Mar. 2/51	Mar. 2/51
Storage period (days).....			21	29	34	30	29	29
Sampling temperature, °C.....			3.3			7.2	5.6	1.7
Test temperature, °C.....			24.0	20.3	20	21.3	20.3	20.3
Dissolved oxygen.....								
Carbon dioxide (CO ₂).....	0.4							
pH.....	6.6	6.2	7.5	6.8	6.6	7.6	7.2	7.3
Colour.....		0	10	5	45	7	15	7
Turbidity.....		0	3	0.4	0.7	0.5	2	0.5
Suspended matter, dried at 105°C.....								
Suspended matter, ignited at 550°C.....								
Residue on evaporation, dried at 105°C.....		30.0	13.0	16.6	26.0	38.2	78.4	22.4
Ignition loss at 550°C.....				6.0	8.6	13.0	8.2	18.4
Specific conductance (micromhos at 25°C.).....				15.2	22.0	17.0	54.2	105
Calcium (Ca).....	1.4	2	0.8	1.8	2.6	5.5	9.3	2.3
Magnesium (Mg).....	0	0	0.3	0.3	0.2	0.8	2.7	0.6
Iron (Fe) Total.....		0.1	0.1					
Dissolved.....				0.04	0.01	0.22	0.03	0.02
Sodium (Na).....				0.4	1.9	0.4	1.4	7.4
Potassium (K).....				0.2	0.2	0.2	0.2	1.1
Carbonate (CO ₃).....	0	0	0	0	0	0	0	0
Bicarbonate (HCO ₃).....	3.2	3.1	2.4	4.9	9.8	10.7	40.0	8.8
Sulphate (SO ₄).....	0	0	1.0	4.3	1.5	10.7	7.7	2.6
Chloride (Cl).....	0.5	10	0.5	3.6	0	0.7	6.4	3.9
Fluoride (F).....				0	0		0.1	0.15
Nitrate (NO ₃).....				0.6	0.4	0.5	0.4	6.2
Silica (SiO ₂) Gravimetric.....				3.4		5.6		
Colorimetric.....	1.4	6.8	1.9	2.5	2.8	7.7	17.3	1.8
Carbonate hardness, as CaCO ₃ , p.p.m.....	2.6	2.5	2.0	4.0	7.3	8.8	32.8	7.2
Non-carbonate hardness, as CaCO ₃ , p.p.m.....	0.8	0.5	1.2	1.7	0	8.2	1.5	1.0
Total carbonate hardness, as CaCO ₃ , p.p.m.....	3.4	3.0	3.2	5.7	7.3	17.0	34.3	8.2
Saturation index.....	-4.1	-4.4	-3.4	-3.7	-3.5	-2.1	-1.8	-2.9
Sum of constituents.....		aluminium-0.05	6.8	17.4	13.2	32.7	77.9	18.3
Remarks:	* Data supplied by Pacific Mills, Ltd.							
	Note corrosive saturation index.							

DESCRIPTION OF MUNICIPAL WATER SYSTEMS

1. SKEENA RIVER DRAINAGE BASIN, B.C.

Prince Rupert—4,761 acres (Incorporated as a city, March 1910)

Population: 6,714 (1941)
9,200 (Est.) (1948)
10,000 (1950)
8,546 (1951)^o

Date of Survey: August 28, 1950.
Ownership: Municipally owned and operated.
Source of Supply: Woodworth Lake, 7 miles distant.
Treatment: Water from lake flows by gravity to system with treatment by chlorine and ammonia (chloramine): chlorine at rate of 3 lbs. per m.g. and ammonia at rate of 1.5 lbs. NH_3 to 10 lbs. chlorine. Ammonia is not always used. A booster pump is required to supply certain sections of the city.
Storage Capacity: One reservoir, 1.25 m.g.
Consumption: Average: 3.5 m.g.d.
Industrial Use: Main users are several fish companies, a drydock, Northern British Columbia Power Company, Limited and Canadian National Railways. Total industrial use is about 30 to 40 per cent of the total consumption.

Smithers—950 acres

(Incorporated as a village, October 1921)

Population: 759 (1941)
1,492 (1948)
1,400 (1949)—not all served, as there are only 290 services.
1,204 (1951)^o

Date of Survey: August 31, 1950.
Ownership: Municipally owned and operated.
Source of Supply: Bulkley River nearby.
Treatment: System started in 1949. No treatment; water is pumped from river to elevated tank and system. When river is dirty, water is taken from infiltration gallery (60 feet natural filtration). Chlorination of supply is planned and it is expected that about 6 to 7.5 lbs. of chlorine per m.g. will be required.
Storage Capacity: One elevated tank, 0.1 m.g.
Consumption: Average: about 50,000 g.p.d.
Industrial Use: No major industrial user; a divisional point on Canadian National Railways.

Terrace—349 acres

(Incorporated as a village, December 1927)

Population: 355 (1941)
750 (1948); 232 services.
960 (1950); (In municipality 800; outside municipality 160.)
961 (1951)^o

Date of Survey: August 29, 1950
Ownership: Municipally owned and operated.
Source of Supply: Springs and creeks.
Treatment: No treatment; water is pumped from springs directly to elevated tanks on nearby hills and thence to system by gravity. Plant capacity, 0.25 m.g.d.
Storage Capacity: Two elevated tanks, 70,000 gallons each.
Consumption: Average: about 70,000 g.p.d.
Industrial Use: Main users are camps of the Columbia Cellulose Company, a hospital, and the Provincial Infirmary.

^o Population given in "Ninth Census" of Canada.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.

Alberni—1,320 acres

(Incorporated as a city, January 1913)

Population: 1,807 (1941)
2,600 (Est. 1948)
3,000 (1949)
3,323 (1951)*

Date of Survey: August 18, 1949.
Ownership: Municipally owned and operated.
Source of Supply: Roger Creek, which is fed by Copper Creek and Yellowstone Creek, principally the latter.
Treatment: Water flows by gravity from Copper Creek to Yellowstone Creek and then to Roger Creek, which is dammed. Water then flows by gravity to tank on side of hill near the town and then to system. Chlorination of the water was started recently.
Storage Capacity: One wooden tank, 150,000 gallons.
Consumption: No record; estimated average, 0.6 m.g.d.
Industrial Use: No major industrial user; primarily a residential area. The area has considerable logging, sawmilling, and fishing activity.

Campbell River—709 acres

(Incorporated as a village, June 1947)

Population: 2,500 (Est. 1948)
1,250 (1949) served with water.
1,986 (1951)*

Date of Survey: August 16, 1949.
Ownership: Municipally owned and operated.
Source of Supply: Campbell River (Elk Lake).
Treatment: Water flows by gravity from penstock of the B.C. Power Commission's plant at John Hart Dam on Elk Lake, some miles upstream from the town, with chlorination enroute.
Storage Capacity: None.
Consumption: No record, but all will be metered; consumption expected to be about 0.16 m.g.d.
Industrial Use: No major industry; main activity is fishing, logging and tourism.
Remarks: System was being installed at time of survey visit and was not yet in operation.

Chemainus

(Unincorporated; in District of North Cowichan)

Population: 1,500 (Est. 1948)
2,500 (Est. 1949)
2,300 (1951)*

Date of Survey: August 19, 1949; Jan. 24, 1950.
Ownership: Privately owned and operated by the Victoria Lumber Co. Ltd., Chemainus, B.C.
Source of Supply: Fullers Lake and Miller Creek, (Chemainus River, North Fork).
Treatment: Miller Creek is piped into Fullers Lake, which flows by gravity into system with chlorination enroute.
Storage Capacity: None, except Fullers Lake, 62 acres.

* Population given in "Ninth Census" of Canada.

* Data from "Municipal Utilities" directory, 1951.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Continued

Chemainus—Concluded

Consumption:

	Average m.g.d.	Maximum m.g.d.	Minimum m.g.d.
Domestic.....	0.208	0.25	0.167
Industrial.....	0.208	0.25	0.063
Total.....	0.416	0.50	0.230

Industrial Use:

Main user is the Victoria Lumber Co., Ltd., which uses water in boilers, in mill, etc. Fishing is also a local industry.

Colwood (Unincorporated)

Colwood community is supplied with water from Greater Victoria Water Board and is included in this area. Colwood is in the Sooke-Port Renfrew district, part of which area is also supplied with water by Saseenos Water, Light and Power Co.

Comox—640 acres (includes 225 acres water) (Incorporated as a village, January 1946)

Population: 650 (Est. 1948)
714 (1951)°

Date of Survey: Aug. 16, 1949.

Ownership: Owned and operated by Courtenay Municipal Waterworks.

Source of Supply: Comox is supplied with water by Courtenay, B.C.

Treatment: See Courtenay, B.C.

Storage Capacity: One elevated tank, 50,000 gallons.

Consumption: No data.

Industrial Use: Primarily a residential district.

Courtenay—840 acres (Incorporated as a city, January 1915)

Population: 1,737 (1941)
2,200 (Est. 1948)
3,500 (1949); (In municipality 2,500; outside municipality
1,000*).
2,553 (1951)°

Date of Survey: August 16, 1949.

Ownership: Municipally owned and operated.

Source of Supply: Brown's River, 4 miles distant.

Treatment: No treatment; water from river flows by gravity from reservoir through settling basin to system. Part is pumped into an elevated tank to serve a section of Comox, B.C.

Storage Capacity: One concrete reservoir, 0.5 m.g.

Consumption: One wood tank, 50,000 gallons. (See Comox).

Average: about 0.8 m.g.d.

Industrial Use: Main users are a creamery and a fish hatchery. Locality is sustained by logging, agriculture, and tourism.

° Population given in "Ninth Census" of Canada.

* Includes communities of Comox, Royston and, Sandwick.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Continued

Crofton (Unincorporated)

Population: about 400 (1949)

Served by North Cowichan District Municipality. (See below.)

Cumberland—66 acres

(Incorporated as a city, January 1898).

Population: 885 (1941)

1,000 (Est. 1948)

2,000 (Est. 1949)—includes outlying area.

971 (1951)^a

Date of Survey: August 16, 1949.

Ownership: Originally privately owned by Cumberland & Union Waterworks Co., Ltd.; later under control of B.C. Power Commission, but at date of survey the town was considering purchase of the system.

Source of Supply: Watershed in nearby mountains; four dams on streams, including Hamilton Creek, allow water to flow to Comox Lake through spillway.

Treatment: No treatment; water is taken by gravity from behind fourth dam to system.

Storage Capacity: Four open reservoirs behind dams, 1 m.g., 16 m.g., 38 m.g., and 66 m.g. each; total capacity, 121 m.g.

Consumption: No record; estimated average, 1 m.g.d.

Industrial Use: No major industrial user. This town is an important coal mining centre.

Cowichan Bay

(Unincorporated)

Twenty services in the area are supplied by the Cowichan Bay Waterworks District, which is in the Duncan area.

Duncan—500 acres

(Incorporated as a city, March 1912)

Population: 2,189 (1941)

3,000 (Est. 1948)

4,500 (1949); (In municipality 3,000; outside municipality 1,500)

2,784 (1951)^a

Date of Survey: August 19, 1949.

Ownership: Municipally owned and operated.

Source of Supply: Skinner Creek and Cowichan River.

Treatment: In the winter, water is pumped from the Cowichan River nearby. In summer, water from Skinner Creek flows by gravity to reservoirs and system. Occasionally Cowichan River also used in summer. Chlorination is carried out at rate of 2.5 lbs. per day (5 lbs. per m.g.).

Storage Capacity: One open reservoir (gravity system) 1.5 m.g.; one closed, concrete reservoir in town, 0.25 m.g.

Consumption: Average: 0.35 m.g.d.

Industrial Use: Main industries are logging and lumbering. In town the major users are dairies and an ice plant. Considerable dairy and poultry farming in the district.

Esquimalt

Included below in Esquimalt District Municipality, being served by Greater Victoria Water Board.

^a Population given in "Ninth Census" of Canada.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Continued

Esquimalt District Municipality—1,500 acres

Population: 3,747 (1941)
6,500 (1949)—population served.
10,153 (1951)°

Date of Survey: August 12, 1949.
Ownership: Municipally owned and operated by Greater Victoria Water Board.
Source of Supply: Water is supplied by the Greater Victoria Water Board.
Treatment: *See* Victoria, B.C.
Storage Capacity: None.
Consumption: Average: about 0.66 m.g.d.
Industrial Use: Esquimalt is an important ship-building and ship-repair centre; fish curing.

Fulford Harbour (Unincorporated)

Fulford Harbour Waterworks District supplies 34 services with water; estimated population served, 140.

Ganges (Unincorporated)

Ganges Water and Power Co. Ltd. supplies 112 services with water; estimated population served 450: later organized into North Saltspring Waterworks District.

Greater Victoria Water Board (District)

Population: 75,218 (1941)
102,900 (Est. 1948)
105,900 (1949)—total population served.
98,450 (1951)°—total metropolitan area served (Est.)

Date of Survey: August 12, 1949.
Ownership: Municipally owned and operated district services.
Source of Supply: Sooke Lake and Goldstream Lake.
Treatment: *See* Victoria, B.C.
Storage Capacity: See Victoria and Districts supplied; total capacity 165 m.g.
Consumption: See individual municipalities.
Industrial Use: See Victoria and other communities served, namely Sooke, Langford, Colwood and District Municipalities of Esquimalt, Oak Bay, and inner part of Saanich. The area is mainly residential.

Ladysmith—220 acres (Incorporated as a city, June 1904)

Population: 1,706 (1941)
2,100 (Est. 1948)
2,500 (1949); (In municipality, 2,000; outside municipality, 500)
2,094 (1951)°

Date of Survey: August 18, 1949.
Ownership: Municipally owned and operated.
Source of Supply: Stocking Lake, 5 miles distant.
Treatment: No treatment; water flows from lake by gravity.
Storage Capacity: One open reservoir, 220,000 gallons.
Consumption: Estimated average: 0.63 m.g.d.
Industrial Use: No main industrial user; lumbering in the interior is the main industry of the district. Ladysmith is also the terminus of a Canadian Pacific Railway rail barge.

° Population given in "Ninth Census" of Canada.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Continued

Lake Cowichan—593 acres (Incorporated as a village, August 1944)

Population:	663 (1941)
	1,475 (Est. 1948)
	1,628 (1951)*
Date of Survey:	Data from Regional Industrial Index, 1948.
Ownership:	Data from "Municipal Utilities" directory, 1951.
Source of Supply:	Municipally owned and operated.
Treatment:	Stanley Creek.
Storage Capacity:	No treatment.
Consumption:	Impounding reservoir, 0.1 m.g.; two elevated tanks, 94,000 gallons.
Industrial Use:	Average in 1951: about 0.2 m.g.d.
	Main industries of district are logging and sawmilling.

Langford (Unincorporated)

Langford is included in the Greater Victoria Water district and is within the Sooke-Port Renfrew area.

Maple Creek (Unincorporated)

See North Cowichan District Municipality.

Nanaimo—1,082 acres (Incorporated as a city, December 1874)

Population:	6,635 (1941)
	7,500 (1948)
	7,200 (1949)
	7,196 (1951)*; 10,700*
Date of Survey:	August 18, 1949.
Ownership:	Municipally owned and operated.
Source of Supply:	South Fork of Nanaimo River, about 15 miles distant.
Treatment:	The water flows by gravity from the river to a 13 m.g. reservoir 2 miles from city, and then enters system by gravity. Chlorination was initiated during the latter part of the war.
Storage Capacity:	Two open reservoirs, 13 m.g. and 350 m.g.
Consumption:	Average: 2.45 m.g.d.
Industrial Use:	Major industries are sawmills, a foundry, soft drink manufacture and Canadian Pacific Railway. There are fifteen metered, large and small industries, and five unmetered; coal-mining nearby.
Remarks:	A plant to produce paper pulp was being constructed near Nanaimo, but this plant will have its own water supply.

North Cowichan District Municipality

Population: 800 total (400 in Maple Creek, B.C. (1949); 400 in Crofton, B.C.)

2,000 (1951)*; 6,665 (1951)*—whole district.

Date of Survey:	August 19, 1949.
Ownership:	Municipally owned and operated.
Source of Supply:	Mountain creeks. In 1951, also one shallow well.

* Population given in "Ninth Census" of Canada.

* Data from "Municipal Utilities" directory, 1951; presumably population served.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Continued

North Cowichan District Municipality—Concluded

Treatment: No treatment; water will flow to system by gravity. System was under construction and is to supply the Maple Creek area and the Crofton area within the district municipality.

Storage Capacity: One elevated tank, 5,000 gallons; one reservoir, 1 m.g.

Consumption: No record.

Industrial Use: Residential areas.

Oak Bay—2,552 acres (District Municipality)

Population: 9,700 (1948)
12,000 (1949)
11,960 (1951)°

Date of Survey: August 12, 1949.

Ownership: Municipally owned and operated.

Source of Supply: Purchased from Greater Victoria Water Board.

Treatment: *See Victoria, B.C.*

Storage Capacity: Three tanks, 2,000 gallons each.

Consumption: Average: 1.25 m.g.d.; *see also* Victoria, B.C.

Industrial Use: A residential area.

Parksville—852 acres (Incorporated as a village, June 1945)

Population: 425 (1941)
900 (1948)
About 900 (1951)
882 (1951)°

Date of Survey: January 1951: data from municipal officials.

Ownership: Municipally owned and operated.

Source of Supply: Springs.

Treatment: No treatment; water is pumped direct to system and tank.

Storage Capacity: One wooden tank, 40,000 gallons.

Consumption: About 5,000 g.p.d.; capacity of springs 0.125 m.g.d.

Industrial Use: Mainly a summer resort; but some logging.

Port Alberni—2,170 acres (Incorporated as a city, March 1912)

Population: 4,584 (1941)
7,800 (Est. 1948)
8,000 (Est. 1949)
7,845 (1951)°; 9,000 (1951)*

Date of Survey: August 17, 1949.

Ownership: Municipally owned and operated.

Source of Supply: China Creek, 7 miles distant, in mountains.

Treatment: No treatment; water flows by gravity from reservoir in mountains to system.

Storage Capacity: Two reservoirs with a total capacity of about 3 m.g.

Consumption: Average: normally 1 m.g.d. with 60 per cent increase during the summer months.

Industrial Use: Main industries are lumbering, sawmilling and production of plywoods; fishing and fish processing; a co-operative and the Esquimalt & Nanaimo Railway (Can. Pacific Ry.) also use this water.

Remarks: A large plant producing paper pulp, started in 1948, has its own water supply from Sproat Lake.

° Population given in "Ninth Census" of Canada.

* Data from "Municipal Utilities" directory, 1951.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Continued

Qualicum Beach—1,157 acres (Incorporated as a village, May 1942)

Population: 259 (1941)
550 (1948)
1,100 (1949) (340 services)
771 (1951)^c

Date of Survey: August 18, 1949.
Ownership: Municipally owned and operated.
Source of Supply: Whisky Creek; wells.
Treatment: No treatment; water flows by gravity to system.
Storage Capacity: Dammed creek and one 30,000 gallon tank.
Consumption: 100 gallons per capita; varies widely owing to varying population.
Industrial Use: An important summer resort.

Royston (Unincorporated)

Royston is included with Courtenay, B.C., whose system supplies this community with water.

Saanich District Municipality

Population: 18,173 (1941)
28,481 (1951)^c; 25,000 (1951)*

Date of Survey: 1948.
Ownership: Municipally owned and operated.
Source of Supply: Inner section of municipality purchases water from the Greater Victoria Water Board; the other section uses the Sayward-Piercey well system (144 services).
Treatment: Well water is pumped direct to tank and system; *See* Victoria for treatment of water supplied by Greater Victoria Water Board.
Storage Capacity: One tank, 0.25 m.g.; one reservoir, 7 m.g.
Consumption: 1.1 m.g.d. (winter); 5 m.g.d. (summer); about 0.25 m.g.d. of well water used.
Industrial Use: No data.

Sandwick (Unincorporated)

Sandwick is included with Courtenay, B.C., whose system supplies this community with water.

Shawinigan Lake (Unincorporated)

Population: 450** (Est. 1950)

Date of Survey: 1950.
Ownership: Privately owned and operated.
Source of Supply: Shawinigan Lake, nearby.
Treatment: No treatment; water pumped direct to system.
Storage Capacity: No data.
Consumption: No record.
Industrial Use: No major industrial user. The area is primarily a summer resort with some sawmilling and logging.

^c Population given in "Ninth Census" of Canada.

^{*} Data from "Municipal Utilities" directory, 1951; presumably population served.

^{**} Not all served (20 services only).

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Continued

Sidney (Unincorporated)

Population: 1,800 (Est. 1948)
2,600 (Est. 1949) including district* served; 1,850 (Est. 1951)
Date of Survey: August 20, 1949.
Ownership: Municipally owned and operated by Sidney Waterworks District.
Source of Supply: Three shallow wells and a spring on hillside near town. Two wells (24 feet deep) are close together at reservoir.
Treatment: No treatment; water is pumped direct from the two 24-foot wells into an underground reservoir nearby. The other well may also be pumped into the reservoir, but it is seldom used. Spring runs by gravity into elevated tank higher up on hillside. Water from tank and ground reservoir flows to system by gravity.
Storage Capacity: Underground reservoir; one elevated tank, 0.2 m.g.d.
Consumption: Average: 0.135 m.g.d. as follows:

	g.p.d.
No. 1 well.....	96,000
No. 2 well.....	2,500
Spring.....	5,000

Industrial Use: No major industrial user; agriculture and tourists.

Sooke (Unincorporated)

Population: 1,500 (1951)
Included with Greater Victoria Water Board; *see also* Victoria, B.C. Sooke lies within the Sooke-Port Renfrew district.

Vesuvius Bay

Population: 281 (1951)^c

Only a very small population is served in the Vesuvius Bay Waterworks District.

Victoria—4,640 acres (Incorporated as a city, August 1862)

Population: 44,068 (1941)
61,400 (1948)
51,331 (1951)^e

Date of Survey: August 12, 1949.
Ownership: Municipally owned and operated distribution system.
Source of Supply: Sooke Lake and Goldstream Lake. A section of the city is supplied by each, and other sections have a mixture.
Treatment: Water flows by gravity from both sources to reservoirs and then to system with chlorination at rate of 7 lbs. per m.g. (0.4 to 0.7 p.p.m.) to give residual of 0.15 to 0.2 p.p.m. Ammonia is added as a gas in ration of 1NH₃:5Cl₂ to form chloramine.
Storage Capacity: Reservoirs, 25 m.g., 136 m.g., 16 m.g.; One elevated tank, 93,750 gals.; Sooke Lake, 3,400 m.g.; Goldstream Lake, 3,606 m.g.
Consumption: Average: 13.64 m.g.d. including Esquimalt; per capita, 127 g.p.d.; domestic use, 55 g.p.d. per capita.

^e Population given in "Ninth Census" of Canada. ^{*}Portion of Central Saanich District Municipality.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

2. VANCOUVER ISLAND AREA, B.C.—Concluded

Victoria—Concluded

Industrial Use: Canadian Pacific Ry. Hotel, Offices, etc.—56.3 m.g. per yr.; Dept. of National Defence (naval establishments at Esquimalt)—56.3 m.g. per yr.; Victoria Phoenix Brewing Co., Ltd.—13.1 m.g. per yr.; B.C. Forest Products Ltd.—11.2 m.g. per yr.; Royal Jubilee Hospital—18.8 m.g. per yr.; Sidney Roofing & Paper Co., Ltd.—548.86 m.g. per yr.; Provincial Government services—15 m.g. per yr. There are also a number of smaller industrial users.

Remarks: This system is now operated by the Greater Victoria Water Board, which also supplies Saanich, Oak Bay, Sooke, Esquimalt, and district.

Youbou (Unincorporated)

B.C. Forest Products, Ltd. supply a few services at Youbou, which is a logging community lying within the Lake Cowichan district area.

3. COASTAL BRITISH COLUMBIA

Bowen Island

Date of Survey: Population: about 1,000 (1950)
January 27, 1951.

Ownership: Privately owned and operated by Union Estates Ltd. (Union Steamships Ltd.).

Source of Supply: Trout Lake, nearby.

Treatment: Lake water flows by gravity from small intake basin, located downstream from Trout Lake. Minimum chlorination is carried out.

Storage Capacity: One tank, 10,000 gallons.

Consumption: Estimated at 275,000 g.p.d.

Industrial Use: Bowen Island is primarily a summer resort for Union Steamships Ltd. employees.

Britannia Beach

Date of Survey: Population: 1,500 (1951)
June 21, 1951.

Ownership: Owned and operated by the Britannia Mining and Smelting Co., Ltd.

Source of Supply: Britannia Creek and tributaries including Furry Creek.

Treatment: No treatment known.

Storage Capacity: No data.

Consumption: No data.

Industrial Use: A copper mining and smelting area; also some logging.

Cranberry Lake—255 acres (Incorporated as a village, June 1942)

Population: 836 (1941) (Est.)
1,250 (Est. 1948)
1,300 (1951)
1,350 (1951)^o

Date of Survey: April 12, 1951.

Ownership: Distribution system owned by Cranberry Waterworks District; springs and storage tanks owned by Powell River Co. Ltd

^o Population given in "Ninth Census" of Canada.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Continued

3. COASTAL BRITISH COLUMBIA—Continued

Cranberry Lake—255 acres—Concluded

Source of Supply:	Powell Lake; purchased from Powell River Co. Ltd.
Treatment:	<i>See Powell River.</i> Water flows by gravity from storage tank to Cranberry Lake system.
Storage Capacity:	One storage tank, 100,000 gallons, owned by Powell River Co. Ltd.
Consumption:	Average: 150,370 g.p.d.; maximum, 0.30 m.g.d.
Industrial Use:	This is principally a residential area for employees of the Powell River Co. Ltd., and adjacent logging operations.

Gibsons Landing—502 acres

(Incorporated as a village, March 1929)

Population: 1,100 (1951) (In municipality, 900; outside municipality, 200).
722 (1951)*

Date of Survey:	January 1951.
Ownership:	Municipally owned and operated.
Source of Supply:	Springs.
Treatment:	No treatment; water is pumped to tank and system.
Storage Capacity:	One tank, 30,000 gallons, and one open reservoir, 500,000 gallons.
Consumption:	No data.
Industrial Use:	Main industrial use is the manufacture of jam.

Ocean Falls

(Unincorporated)

Population: 2,830 (1951)

Date of Survey:	February 1951.
Ownership:	Privately owned, and operated by Pacific Mills Ltd.
Source of Supply:	Link Lake, nearby.
Treatment:	No treatment; water enters system by gravity except for necessary pumping to fill townsite elevated tank.
Storage Capacity:	One elevated tank, 100,000 gallons.
Consumption:	Average domestic use, 0.536 m.g.d.; average industrial use 1,260 m.g.d. (process water, 60 m.g.d.; power, 1,200 m.g.d.)
Industrial Use:	Main industrial users are Pacific Mills Ltd. and Northern Pulpwood Co., Ltd.

Powell River

(Unincorporated)

Population: 5,000 (1951) (In municipality, 3,500; outside municipality, 1,500*).
3,400 (1951)

Date of Survey:	January 1951.
Ownership:	Privately owned, and operated by the Powell River Co. Ltd.
Source of Supply:	Powell River (Powell Lake).
Treatment:	Water flows by gravity to the system and tanks with chlorination at rate of 35 lbs. per 24 hours.
Storage Capacity:	Two tanks, 15,000 gallons each; also Powell Lake.
Consumption:	Average, 0.50 m.g.d.; maximum, 0.65 m.g.d.; minimum, 0.36 m.g.d.
Industrial Use:	Industrial use: average, 87 c.f.s.; maximum 102 c.f.s.; minimum, 47 c.f.s. Main user is Powell River Co. Ltd., who manufacture pulp and paper.

* Population given in "Ninth Census" of Canada.
* Probably includes Cranberry Lake, B.C.

DESCRIPTION OF MUNICIPAL WATER SYSTEMS—Concluded

3. COASTAL BRITISH COLUMBIA—Concluded

Sechelt (Unincorporated)

Date of Survey:	Population: about 1,000 (245 services)
Ownership:	January 27, 1951.
Source of Supply:	Privately owned, and operated by Union Estates (Union Steamships Ltd.).
Treatment:	Chapman Creek nearby.
Storage Capacity:	No treatment; water flows by gravity to reservoir and system.
Consumption:	One tank, 50,000 gallons.
Industrial Use:	Average: about 36,750 g.p.d.
	No major industrial user.

Squamish (Incorporated as a village, May 1948)

Population:	500 (Est. 1948)
	1,290 (Est. 1951) (In municipality, 720; outside municipality, 570).
	589 (1951)°

Date of Survey:	February 2, 1951.
Ownership:	Privately owned and operated by Pacific Great Eastern Railway Co.
Source of Supply:	Stawamus River, 3 miles distant.
Treatment:	No treatment; water flows by gravity (400-foot head) through old hydro-electric flume and is bled-off to system and tanks under 75 p.s.i. pressure.
Storage Capacity:	Three tanks: 10,000, 25,000 and 60,000 gallons. The 60,000-gallon steel tank is for emergency use only.
Consumption:	Average: about 60,000 g.p.d.
Industrial Use:	Main industrial user is the Pacific Great Eastern Railway.

Stewart

Population: 446 (1941); 283 (1951)°

No data on system or water quality obtained. Stewart Public Utilities supply 53 domestic services with water.

Westview—1,562 acres (Incorporated as a village, June 1942)

Population:	1,853 (1941)
	2,300 (1948)
	3,125 (1951) (In municipality, 3,000; outside municipality, 125).
	3,507 (1951)°

Date of Survey:	February 1951.
Ownership:	Westview Light, Power and Waterworks Improvement District.
Source of Supply:	Springs and West Lake.
Treatment:	No treatment; all waters enter system and reservoirs by gravity.
Storage Capacity:	Three tanks, total capacity 80,000 gallons.
Consumption:	No record.
Industrial Use:	An ice plant; area is chiefly residential for Powell River Co. Ltd.

Woodfibre (Unincorporated)

Population: 1,000 (1951)

British Columbia Pulp and Paper Co. Ltd. supply approximately 160 services by system administered by B.C. Department of Municipal Affairs, Victoria, B.C.

° Population given in "Ninth Census" of Canada.

TABLE IV
MUNICIPAL WATER SUPPLIES
Summary of data on area, total population and population served

Region	Area, square miles	Total population in thousands			Total population served with water		Per cent population served	Per cent population served (1949-50) with			
		1941 census	1949-50 ^b	1951 census	1949-50 ^c	1951 census		1949-50	Soft water	Medium water	Hard water
Skeena River basin.....	21,000	12.6	16.0	16.9	12.1	12.3	74.2	100	.....	.....	.....
Vancouver Island ^a (Census Division 5).....	13,210	150.4	202.1	215.0	148.3	147.2	70.8	97.6	2.4	.....	.....
Coastal British Columbia.....	97,200	30.8	39.7	41.9	17.8	18.1	44.0	100	.....	.....	.....
Total.....	131,410	193.8	257.8	273.8	178.2	177.6	66.9	.....	.....	.....	.....
Total province.....	366,255	817.9	1,095.7	1,185.2	.....	.....	.....	.....	.....	.....	.....

^a Includes several nearby coastal islands.

^b Population estimated as proportionate between 1941 and 1951 Census figures.

^c Population served as reported by municipal officials.

TABLE V
MUNICIPAL WATER SUPPLIES
Summary of data on systems including source, treatment, and hardness of waters

Region	Number of muni- cipal- ties	Number of systems	Number of systems using surface water				Number of systems using ground water				Percentage of systems using surface waters (1949-50)	Treatment		
			Soft	Medium hard	Hard	Very hard	Soft	Medium hard	Hard	Very hard		None	Chlor- ination only	Additional treatment
Skeena River basin.....	3	3	3	0	0	0	0	0	0	0	100	1	1	1 ^b
Vancouver Island.....	33	22	19	0	0	0	1	2	0	0	86.8	15	6	1 ^a
Coastal British Columbia.....	11	10	10 ^a	0	0	0	0	0	0	0	100	8	2	0
Total.....	47	35	32	0	0	0	1	2	0	0	91.4	24	9	2

^a One system also used springs or ground water and is, therefore, a mixed supply.

^b Naturally filtered.

^c No chlorination; settled prior to use.

DISCUSSION

From Table IV it is seen that the area studied in this report comprises about 36 per cent of the total area of the province and contains about 23 to 24 per cent of the total provincial population. About 67 per cent of this population is supplied with water by organized systems, almost 98 per cent of the supplied water being soft in character.

In preparing this table the total population figures for 1941 and 1951 are taken from the eighth and ninth census of Canada supplied by the Dominion Bureau of Statistics. The total population as given for the 1949 to 1950 period is calculated from the census figures by assuming a proportionately constant increase for the 8 years from 1941 to 1949. This, of course, may not necessarily be true because of population shifts during the war, recent industrial activity, etc.

It will be noted that there is some disagreement in the estimated population served with water in the period 1949 to 1950 and in 1951. The 1951 figure is obtained from the ninth census of Canada, those localities on which no census data were available being assumed to have four persons per service connection. The 1949-50 figure is an estimate based largely on information supplied by municipal officials during visits and by correspondence. Attention is drawn to the fact that the figure given for the Skeena River basin is determined from information obtained in 1950; for Vancouver Island, from data given to the author in 1949, and the figures for the coastal municipalities were usually supplied early in 1951; hence, the close agreement with the 1951 census figure in this latter area. It is believed that the ninth census figures will be somewhat low, as they do not always include population served outside the incorporated areas by the municipal systems; on the other hand, the tendency for municipal officials to report population in round-figures probably results in the 1949 to 1950 figures being somewhat high. Therefore, the population served with water has been taken as the average of the 1949-50 figure and the 1951 figure, and the total population the average of the total population figures reported for the period 1949 to 1950 and the year 1951. The per cent population is calculated using these average values. Recalculation of "per cent population served", using directly the figures for each period rather than the above average figures for total population and total population served, in most cases does not seriously alter the final "per cent population served."

Table V summarizes the data on the systems and water hardness in the regions under study. Although about forty-seven municipalities, incorporated areas, or districts have organized systems, only about thirty-five of these have separate systems using a different water source. Thirty-two of these thirty-five systems use a soft surface water; only three systems use ground waters, one being served with a soft water, the other two with a medium-hard water; 91.4 per cent of the systems are supplied with soft water.

Only two of the waters are treated other than by chlorination, one being naturally filtered and the other allowed to settle prior to use.

SUMMARY

As would be expected from the information available on surface waters (Table II) the municipal systems in these areas generally use the soft surface waters with little or no treatment.

Where chlorination is carried out this is usually either intermittent or there is a very low demand indicating that to date there is little pollution of surface waters.

Because of the low cost of treatment and in many cases the availability of cheap water from mountain streams without pumping, a rather high percentage of the population is served even though municipalities are often very small and scattered.

The main problems in water use from a municipal and industrial viewpoint are probably the corrosive nature of the waters, the high colour, and in some waters, for short periods, the relatively high turbidity.

It is readily seen that the areas studied have an abundance of unpolluted, soft surface water suitable without too much treatment for domestic and industrial use. It is doubtful therefore if water will ever be a controlling factor in industrial expansion in these areas.

APPENDIX A
SAMPLING LOCATIONS OF SURFACE WATERS

SKEENA RIVER DRAINAGE BASIN

<i>Station No.</i>	PAGE
1. Skeena River, near Skeena, B.C.	10
2. Skeena River, at Telegraph point, B.C.	10
3. Skeena River, near Exstew, B.C.	10
4. Skeena River, at Usk, B.C.	10
5. Skeena River, at Hazelton, B.C.	12
6. Woodworth Lake, near Prince Rupert, B.C.	14
7. Kogia River, near Prince Rupert, B.C.	14
8. Kasiks River, near Salvus, B.C.	14
9. Exchamsiks River, near Salvus, B.C.	14
10. Exstew River, near Exstew, B.C.	14
11. Zymagotitz (Zimacord) River, near Amsbury, B.C.	14
12. Kitsumkalum River, near Terrace, B.C.	14
13. Zymoetz (Copper) River near Copper River, B.C.	16
14. Bulkley River, at New Hazelton, B.C.	16
15. Bulkley River, at Smithers, B.C.	18
16. Bulkley River, at Quick, B.C.	18
17. Bulkley River, near Houston, B.C.	18
18. Telkwa River, near mouth.	18
19. Morice River, near mouth.	18

VANCOUVER ISLAND

<i>Station No.</i>	PAGE
1V. Campbell River, near Campbell River, B.C.	20
2V. Oyster River, near mouth.	20
3V. Tsolum River, near Courtenay, B.C.	20
4V. Brown's River, near Courtenay, B.C.	20
5V. Puntledge River, near Courtenay, B.C.	20
6V. Little Qualicum River, near Cameron Lake, B.C.	20
7V. Englishman River, near Parksville, B.C.	20
8V. China Creek, near Port Alberni, B.C.	20
9V. Roger Creek, at Alberni, B.C.	22
10V. Sproat River, near Alberni, B.C.	22
11V. Great Central Lake, near Alberni, B.C.	22
12V. Nanaimo River (South Fork), near Nanaimo, B.C.	22
13V. Stocking Lake, near Ladysmith, B.C.	22
14V. Chemainus River (North Fork), near Chemainus, B.C.	22
15V. Cowichan River, near Duncan, B.C.	22
16V. Koksilah River, near Duncan, B.C.	22
17V. Shawinigan Lake, near Shawinigan Lake, B.C.	24
18V. Goldstream Lake, near Victoria, B.C.	24
19V. Sooke Lake, near Victoria, B.C.	24

COASTAL AND NORTHERN B.C.

<i>Station No.</i>	PAGE
1C. Stawamus River, near Squamish, B.C.	24
2C. Britannia Creek, at Britannia Beach, B.C.	24
3C. Trout Lake, at Bowen Island, B.C.	24
4C. Chapman Creek, at Sechelt, B.C.	24
5C. West Lake, at Westview, B.C.	24
6C. Powell River, at Powell River, B.C.	24
7C. Link Lake, at Ocean Falls, B.C.	24

APPENDIX B

MUNICIPALITIES WITH ORGANIZED WATER SYSTEMS

1. SKEENA RIVER DRAINAGE BASIN, B.C.

	PAGE
Prince Rupert.....	38
Smithers.....	38
Terrace.....	38

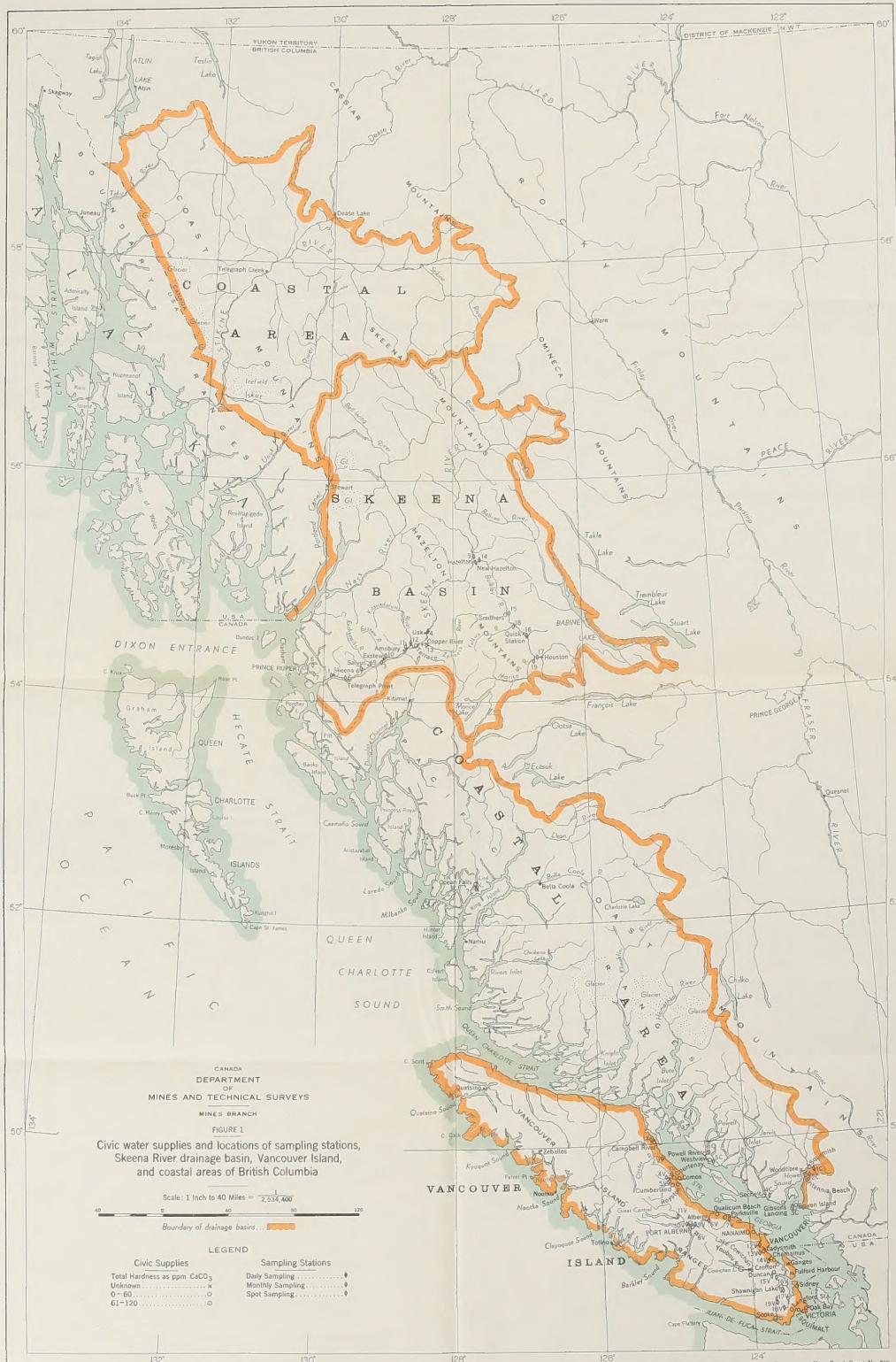
2. VANCOUVER ISLAND AREA, B.C.

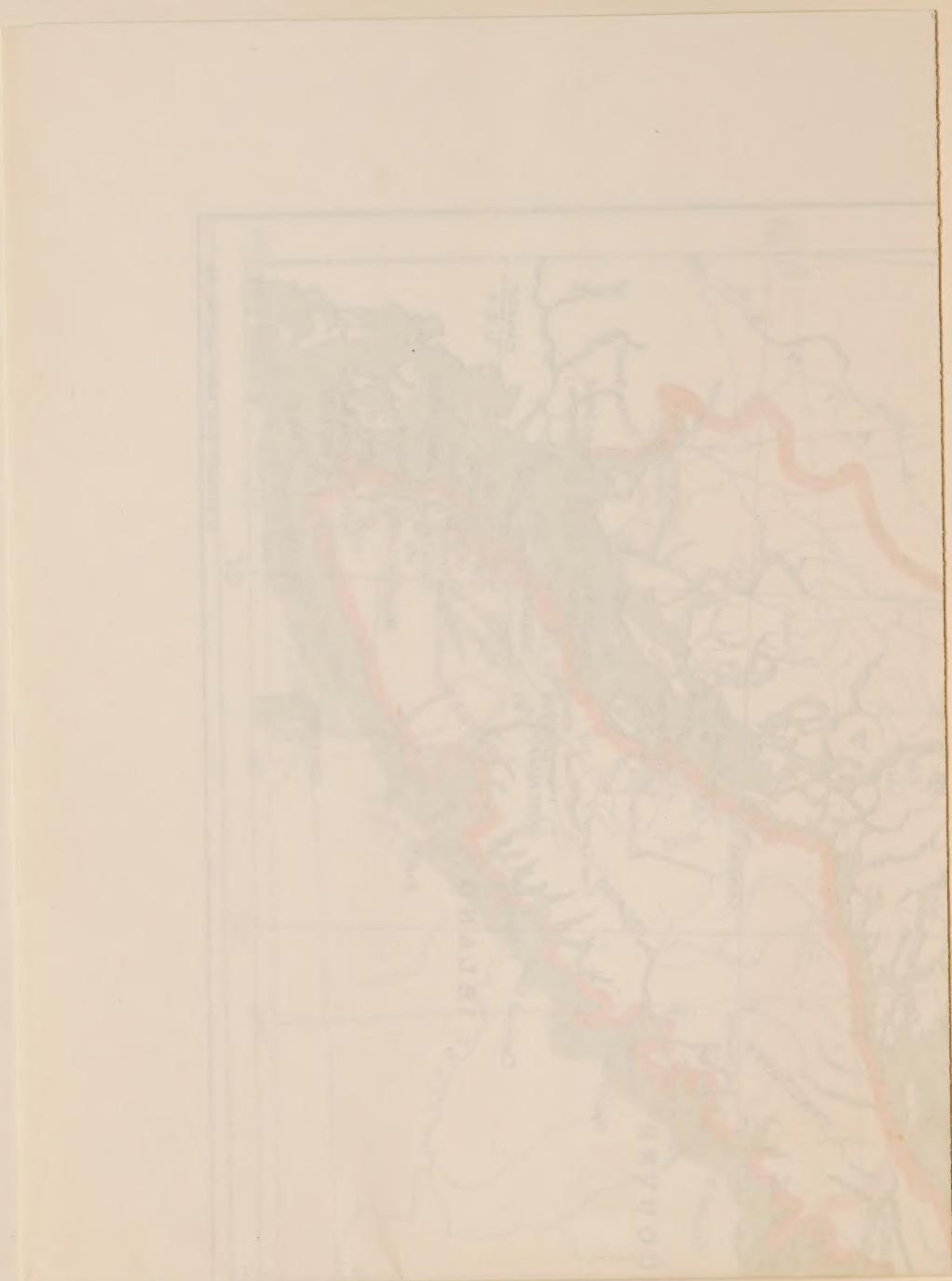
Alberni.....	39
Campbell River.....	39
Chemainus.....	39
Colwood ¹	40
Comox ¹	40
Courtenay.....	40
Crofton ¹	41
Cumberland.....	41
Cowichan Bay.....	41
Duncan.....	41
Esquimalt ¹	41
Esquimalt District ¹	42
Fulford Harbour.....	42
Ganges.....	42
Greater Victoria Water Board (District).....	42
Ladysmith.....	42
Lake Cowichan.....	43
Langford ¹	43
Maple Creek ¹	43
Nanaimo.....	43
North Cowichan.....	43
Oak Bay ¹	44
Parksville.....	44
Port Alberni.....	44
Qualicum Beach.....	45
Royston ¹	45
Saanich District Municipality.....	45
Sandwick ¹	45
Shawinigan Lake.....	45
Sidney.....	46
Sooke ¹	46
Vesuvius Bay.....	46
Victoria ¹	46
Youbou.....	47

3. COASTAL BRITISH COLUMBIA

Bowen Island.....	47
Britannia Beach.....	47
Cranberry Lake ¹	47
Gibsons Landing.....	48
Ocean Falls.....	48
Powell River.....	48
Sechelt.....	49
Squamish.....	49
Stewart.....	49
Westview.....	49
Woodfibre.....	49

¹ Systems are part of other organized systems or districts.





622
C16
M-I
5

